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“Ah Yes, I Remember It Well”[†]: Why the Inherent Unreliability of Human Memory Makes Brain Imaging Technology a Poor Measure of Truth- Telling in the Courtroom

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[†] ALAN JAY LERNER & FREDERICK LOEWE, *I Remember It Well*, in GIGI (MGM Studios, Inc. 1958); see also Videos Interesan, *Gigi* – 22 “*I Remember It Well*,” YOUTUBE (Mar. 31, 2009), <http://www.youtube.com/watch?v=sISWPzEqHLQ>.

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ABSTRACT

It is not often that the science of how the human mind perceives and then retrieves information trends on Twitter, but that was the case over the last year as first the story broke that Brian Williams had, for years, been claiming to witness events he had only seen in photographs.¹ More recently, the world was transfixed by a quirk of visual perception that caused some people to see a dress as white and gold, while others were just as sure it was blue and black.² These events, although matters of pop culture, are important to understanding a very serious legal issue: the inherent unreliability of eyewitness testimony. By now, stories coming from the Innocence Projects established all over the country have shown how often witnesses who are completely confident

¹ See, e.g., Slate (@Slate), TWITTER (Feb. 5, 2015, 3:58 PM), <https://twitter.com/Slate/status/563486932039372800>.

² Jonathan Mahler, *The White and Gold (No, Blue and Black!) Dress That Melted the Internet*, N.Y. TIMES (Feb. 27, 2015), <http://www.nytimes.com/2015/02/28/business/a-simple-question-about-a-dress-and-the-world-weighs-in.html>.

in their identification of a criminal at the initial police lineup, or even at trial, are proved absolutely mistaken.

This Article demonstrates why efforts to develop brain imaging technology that will enhance the human ability to detect deliberate deception are doomed to failure because they are based on false assumptions about how our brains perceive and store information. It does so by bringing together the literature of disparate fields of study, including the laws of evidence involving the admission of eyewitness testimony and forensic science; contemporary advances in neuroimaging; and recent claims of technology that not only detects lies, but actually may extract memories of past events from unwilling witnesses. This Article then explains that the human mind does not passively store events for later retrieval, but rather is always actively engaged in making sense of information of past and present events. Moreover, even while an event is happening, the information perceived by one person may be very different than that perceived by others. Therefore, even if reliable markers for deliberate deception are discovered, they will not necessarily provide reliable information about past events.

“After decades of concerted effort on the part of neuroscientists, psychologists, and philosophers, only one proposition about how the brain makes us conscious—how it gives rise to sensation, feeling, subjectivity—has emerged unchallenged: we don’t have a clue.”³

INTRODUCTION

For a few weeks in February 2015, consumers of popular culture were treated to a compelling example of how difficult it is to draw a line between a false memory and a lie. It is a matter of recorded fact that “Lyn’ Brian” Williams was not in a helicopter hit by enemy fire twelve years ago, despite his frequent and public claims to the contrary.⁴ What has caught the public imagination, however, is whether Williams was acting with the intent to deceive his listeners (lying), or if he had convinced himself, at some point, that the event really happened. His words of apology suggest that he is no more sure of why

³ ALVA NOË, *OUT OF OUR HEADS: WHY YOU ARE NOT YOUR BRAIN, AND OTHER LESSONS FROM THE BIOLOGY OF CONSCIOUSNESS* xi (2009).

⁴ Tom Kludt & Brian Stelter, *How Brian Williams’ Iraq Story Changed*, CNN: MONEY (Feb. 10, 2015, 9:33 PM), <http://money.cnn.com/2015/02/05/media/brian-williams-iraq-timeline/>.

he made those claims than we are.⁵ And Williams’s uncertainty is consistent with how the human brain is put together—neuroscience strongly suggests that, unlike a manuscript where it may always be possible to go back to an earlier draft, what we think of as memories appear in our minds as seamless wholes.

Lerner and Loewe, the team responsible for writing “I Remember It Well,” fully expected that those hearing their song would recognize the discrepancies between the memories of the two protagonists because they have had many similar experiences themselves. All of us may find that we believe that someone who should have been at a particular event, was, and on hearing the facts, go on to remember it differently.⁶ But what we cannot do, and what makes this such an important issue for the courtroom, is retain two memories at once or have an awareness that a memory has been changed. This is significant for making determinations of credibility in a court of law, or anywhere else, because a technology based on identifying physiological signs that an individual is being deliberately deceptive are of no help unless the individual involved is aware of what she is doing.

This Article, therefore, looks critically at the latest iteration of forensic mindreading technology and puts its proponents’ claims in the context of how seamlessly we can lie to ourselves and, as a result, pass on misinformation to others. It begins by surveying opinions on neuroimaging’s potential to provide reliable and accurate determinations of whether an individual is being deliberately deceptive. It also examines claims that, in the future, neuroimaging will actively read the thoughts of a human being undergoing a brain scan. Part II continues by discussing the current custom for using neuroimaging technology in U.S. courts. It then analyzes the science behind neuroimaging, discussing the legal implications of adopting neuroimaging technology into trial practice and how neuroimaging compares to eyewitness testimony, polygraphy, and other forensic sciences. Part III then describes how neuroimaging technology cannot

⁵ See Alessandra Stanley, *Brian Williams, in Raw Form, Delivers an Apology on ‘Today,’* N.Y. TIMES (June 19, 2015), <http://www.nytimes.com/2015/06/20/arts/television/brian-williams-in-raw-form-delivers-an-apology-on-today.html>.

⁶ See Mark Godsey, *We Are Naturally Bad Sleuths.. and Frequently Fail to Find the Truth*, HUFFINGTON POST (Dec. 25, 2013, 5:12 AM), http://www.huffingtonpost.com/mark-godsey/we-are-naturally-bad-sleuths_b_4159351.html (describing the common occurrence of mistaken identification based on eyewitness testimony, as experienced through Mark Godsey’s work with the Ohio Innocence Project).

replace the role of the fact finder, and in actuality creates potential for prejudice in legal proceedings outside of the courtroom as well. Part IV suggests that a moratorium similar to that placed on polygraphy would effectively eliminate the risks described in Part III. And, finally, Part V and the Conclusion give recommendations for the future of neuroimaging technology in the legal system.

I

THE MARKET FOR TRUTH-TELLING TECHNOLOGY

Although it is well established law in both federal and state courts that “[a]n expert witness is not permitted to testify specifically to a witness’ credibility,”⁷ there is money to be made in selling “unbiased methods for the detection of deception and other information stored in the brain”⁸ to lawyers, corporations, governments, and suspicious spouses.⁹ As a result, several private companies have licensed software programs¹⁰ that claim to be able to translate the results of sophisticated brain imaging into reports that draw reliable conclusions about the thoughts of the person being scanned.¹¹ Despite the best efforts of the companies seeking to market this method for forensic use, so far, no court in the United States has accepted these reports to assist finders of fact in their traditional duties of weighing the credibility of all the evidence put before it, whether physical or testimonial.

Given the likelihood that pressure to admit this evidence will continue, it is imperative to the fair operation of the legal system that all involved understand the claims made for the latest in a long line of failed technologies, including polygraphy and phrenology, which have similarly promised to unlock the mysteries of the human mind. This Article considers the issue of fairness in the context of the current legal

⁷ *United States v. Candoli*, 870 F.2d 496, 506 (9th Cir. 1989).

⁸ NO LIE MRI, <http://www.noliemri.com> (last visited Feb. 10, 2016).

⁹ See *Detecting Lies with fMRI*, NEUROSCIENTIFICALLY CHALLENGED (Dec. 12, 2014), <http://www.neuroscientificallychallenged.com/blog/detecting-lies-with-fmri>.

¹⁰ See Matt Wall, *Which fMRI Analysis Software (SPM, BrainVoyager, FSL)?*, COMPUTING FOR PSYCHOLOGISTS (May 3, 2011), <https://computingforpsychologists.wordpress.com/2011/05/03/which-fmri-analysis-software-spm-brainvoyager-fsl/>.

¹¹ See Sarah E. Stoller & Paul Root Wolpe, *Emerging Neurotechnologies for Lie Detection and the Fifth Amendment*, 33 AM. J.L. & MED. 359, 360–61 (2007). The technology is often called “fMRI imaging,” but since the fMRI is merely a piece of medical equipment which produces the data the software analyzes, this is no more specific than calling any item cooked in or on a stove “stove.” Some have suggested that the term “Neurotechnological Lie Detection” be used to describe the general process, *see, e.g., id.* at 360, as opposed to specific proprietary software that interprets the information that a Functional Magnetic Imaging Machine produces.

concerns being raised about the use of all forensic technologies in the courtroom and in particular about those raised by evidence based on human memory.

This Article’s title directly reflects a phenomenon, well recognized by cognitive sciences, which we have all experienced: different people can remember the same event in very different ways. The lyrics of the song, “I Remember It Well” reflect a conversation between two old lovers about the first time they met.¹² The male character confidently recounts details about the season, location, and even color of his partner’s dress which she equally confidently disputes based on her own memory.¹³ What is so significant about the song, and the phenomenon, is that rather than claiming to have forgotten the details or even to be engaging in what would be a fruitless exercise of making them up to appease his partner, the male is as confident that he is recounting facts about their first meeting as the woman is about contradicting them.¹⁴ But they cannot both be correct, can they?

The problem here is one of heuristics. So long as the brain, acting as a digital camera where information from the senses is stored intact for future retrieval, is convinced, we will continue to overvalue the role of memory as we offer it to aid fact finders in the courtroom and elsewhere whether through oral testimony or imaging of brain activity. This Article seeks to change the paradigm of fact finding by rejecting the camera heuristic. Instead, by bringing together current scientific and legal writings, this Article demonstrates that what we now describe as the act of lying, in the sense of deliberately misinforming a jury, is closely related to how human brains process information about the past.

As a result, any technology that claims to bypass volitional deception is misleading, suggesting that there is some form of objective truth obscured by a deliberate lie. Once these claims are understood, the technology can be evaluated in the context of contemporary legal standards for admitting evidence based on forensic scientific technologies in general and in particular of admitting testimony which relies on the content of human memory. There is a gap in scholarship that this Article will fill, explaining the limitations of the current

¹² Maurice Chevalier, *I Remember It Well* (from “Gigi”), MUSIXMATCH, <https://www.musixmatch.com/lyrics/Maurice-Chevalier/I-Remember-It-Well-from-%22Gigi%22> (last updated Dec. 19, 2014) (providing the lyrics to Lerner and Loewe’s 1958 song).

¹³ *Id.*

¹⁴ *See id.*

technology to accurately and reliably produce useful information, and that these limitations are based on reasons inherent to all methods dependent on human memory.

Reliance on a technology that reads memories assumes that the witness or defendant being questioned has available to him an unfiltered depiction of events so that his answers either accurately and honestly do reflect what happened or, through deliberate efforts to deceive, do not. In the context of the technology based on neuroimaging currently being offered as a way of assisting fact finders, this means two things. First, if a machine with one hundred percent accuracy and reliability could detect deliberate deception, it would absolve witnesses of accusations that they are lying. Second, however, even a far more sophisticated technology, which although not available now might well be in the near future, that could actually translate brain activity so that an external observer could see what the subject is remembering, would not be equivalent to reviewing a closed circuit video recording of the event.

The current understanding of how the brain works, which is all we have to assess the usefulness of neuroimaging technology as a forensic tool, suggests that when his memory is of a gold dress and hers of a blue one; only one of them is correct, and it is a jury's job to resolve the dispute should it reach them. Then, the jury must look at all the available external evidence, perhaps there is a dry cleaning receipt, to determine which party is correct.

Could there be uses for a technology that accurately reflects the thoughts as the thinker perceives them? Yes, but not in the context of evidence admitted at a trial. Perhaps flawed information would be better than none in the face of a non-communicative subject and the need to find a ticking bomb or a stolen child. However, even an accurate record of a memory will reflect only the subjective impressions of the eyewitness.¹⁵

¹⁵ See Brian R. Gallini, *Police "Science" in the Interrogation Room: Seventy Years of Pseudo-Psychological Interrogation Methods to Obtain Inadmissible Confessions*, 61 HASTINGS L.J. 529, 570–71 & n.337 (2010). For the purpose of making its argument that direct access to thought would not bring more accurate information to the jury, this Article accepts the claim that it is possible to define "lying." The Reid Institute advertises that it has developed an interview technique which "permit[s] evaluation of a person's truthfulness independent from a polygraph examination." *Critics Corner: The Reid Technique*, JOHN E. REID & ASSOCS., INC., http://www.reid.com/educational_info/criticttechnique.html (last visited Feb. 10, 2016). Its promotional website claims that "[t]his procedure, termed a Behavior Analysis Interview, has become a standard investigative technique, especially since the passage of the Federal Employee Polygraph Act of 1988, which greatly restricts a private employer's use of polygraph." *Id.* Although its sales materials claim to provide

Moreover, a lack of consensus among scientists as to whether juries are unduly swayed when presented with information based on forensic science¹⁶ supports a call for special caution in offering conclusions about whether or not a witness is being actively deceptive. This is because jurors are well aware of their human limits to knowing the contents of another’s thoughts and could well overvalue the findings of a machine that claims extra-human abilities.¹⁷ Thus, it would be a mistake to offer fact finders evidence from a machine which purports to know the contents of a person’s thoughts without a much better understanding of how successfully our brains can fool any of us into the conviction that we remember something in the face of direct contradiction of someone else who was there.

A. The Innocence Project

The Innocence Project is a nonprofit organization founded to “assist prisoners who could be proven innocent through DNA testing.”¹⁸ In the course of its work, the Innocence Project has concluded that eyewitness misidentification is the single greatest cause of wrongful convictions nationwide, “playing a role in more than 70% of convictions overturned through DNA testing.”¹⁹ It is currently engaged

citations to cases where courts have endorsed its technique, see *Legal Updates*, JOHN E. REID & ASSOCS., INC., http://www.reid.com/educational_info/r_updates.html#rt (last visited Feb. 10, 2016), in fact these are cases where courts have admitted confessions obtained using the “Reid Technique” because they do not constitute illegal methods of interrogation, not because they endorse crediting the confessions with any enhanced reliability or accuracy, see, e.g., *State v. Myers*, 596 S.E.2d 488, 492 (S.C. 2004).

¹⁶ See generally Mark A. Godsey & Marie Alou, *She Blinded Me with Science: Wrongful Convictions and the “Reverse CSI-Effect,”* 17 TEX. WESLEYAN L. REV. 481 (2011) (discussing two ways forensic evidence can wrongly influence a jury).

¹⁷ Cf. *United States v. Hill*, 749 F.3d 1250, 1258 (10th Cir. 2014) (“There are several reasons for the prohibition against expert testimony on other witness’ credibility. Such testimony: (1) ‘usurps a critical function of the jury’; (2) ‘is not helpful to the jury, which can make its own determination of credibility’; and (3) when provided by ‘impressively qualified experts on the credibility of other witnesses is prejudicial and unduly influences the jury.’”) (quoting *United States v. Toledo*, 985 F.2d 1462, 1470 (10th Cir. 1993)); *United States v. Beasley*, 72 F.3d 1518, 1528 (11th Cir. 1996) (“Absent unusual circumstances, expert medical testimony concerning the truthfulness or credibility of a witness is inadmissible. . . . because it invades the jury’s province to make credibility determinations.” (citation omitted)).

¹⁸ *Our Work*, INNOCENCE PROJECT, <http://www.innocenceproject.org/free-innocent> (last visited Feb. 10, 2016).

¹⁹ *Eyewitness Misidentification*, INNOCENCE PROJECT, <http://www.innocenceproject.org/causes-wrongful-conviction/eyewitness-misidentification> (last visited Feb. 10, 2016).

in a nationwide advocacy effort to change the law.²⁰ The Innocence Project's primary evidence for the unreliability of the eyewitness testimony as obtained in lineups and presented to juries in court is based on brain science. One Innocence Project website explains that:

As far back as the late 1800s, experts have known that eyewitness identification is all-too-susceptible to error, and that scientific study should guide reforms for identification procedures. . . . Since then, hundreds of scientific studies (particularly in the last three decades) have affirmed that eyewitness identification is often inaccurate—and that it can be made more accurate by implementing specific identification reforms.²¹

The scientific studies of memory on which the Innocence Project bases its claim for the inaccuracy of eyewitness testimony should be seen as strong evidence against the use of information obtained through neuroimaging technology because this evidence, too, is based on memory. Although it has been represented as a new forensic technology that provides unique access to information stored inside the human brain, in fact it is no more than a method of accessing memory.

B. Closed Circuit Video's Ability to Solve Crimes Without Assessing Witness Credibility

Companies offering to provide analysis of neuroimaging data as a way to directly access the thoughts of a potentially unwilling or deceptive subject often make an analogy to the kind of video surveillance that has become almost universal in public places in Great Britain, where it plays a major role in solving crimes.²² American viewers of contemporary British television shows like *MI-5*²³ and *Torchwood*²⁴ are often surprised that the first step in almost any investigation is to “find” or “roll” the Closed Circuit Video (CCV or

²⁰ *Improve the Law*, INNOCENCE PROJECT, <http://www.innocenceproject.org/free-innocent/improve-the-law/legislative-reform> (last visited Feb. 10, 2016).

²¹ *Eyewitness Misidentification*, MIDWEST INNOCENCE PROJECT, <http://themip.org/eyewitness-misidentification/> (last visited Feb. 10, 2016).

²² Beginning with a massive public project in the 1990s most public space in Great Britain is within the view of constantly running closed circuit video cameras. See Clive Norris & Michael McCahill, *CCTV: Beyond Penal Modernism?*, 46 BRIT. J. CRIMINOLOGY 97, 100–02 (2006). For a general description of how CCV is being used for law enforcement, see *id.*

²³ For discussion of an episode of *MI-5*, see Vicky Frost, *Spooks: Series Nine, Episode Three*, GUARDIAN: TV & RADIO BLOG (Oct. 4, 2010, 5:10 PM), <http://www.guardian.co.uk/tv-and-radio/tvandradioblog/2010/oct/04/spooks-series-nine-episode-three>.

²⁴ For a guide to *Torchwood* episodes, see *Torchwood: Episodes*, BBC, <http://www.bbc.co.uk/programmes/b006m8ln/episodes/guide> (last visited Feb. 10, 2016).

CCTV) tape. Once accessed, an agent runs it through the computer which provides an identification.²⁵ There is never, on television at least, any need to find witnesses, let alone extract a confession from the suspect. The police merely track the person down, arrest him, and play the tape for the jury.²⁶

II

THE VALUE AND RELIABILITY OF NEUROIMAGING TECHNOLOGY

The power of the claims made by fMRI technology is particularly dangerous due to both the subjectivity of human memory and the lure of a technology that purports to reveal thought. There is no scientific explanation for how thinking occurs, let alone where in the brain the process occurs.²⁷ Although it has been described as a technology that allows outsiders to "watch [the brain] think[ing],"²⁸ in fact there is no scientific consensus on what thinking is or where it occurs, let alone whether it can be watched. That is why commentators have criticized the colorful, moving images produced from the digital data as deceptive.²⁹

²⁵ Facial recognition software has become so commonplace that it is now available in many phone applications. See, e.g., Orbeus, Inc., *PhotoTime – Automatic Face Sorting & Keyword Tagging for Your Moments*, iTunes PREVIEW, <https://itunes.apple.com/us/app/phototime-automatic-face-sorting/id846435251?mt=8> (last visited Feb. 10, 2016). It is possible for a person to take a picture of a stranger and have the software search the Internet for publicly available information and produce a name, telephone number, and address within seconds. *Facial Recognition Phone Application Described as a 'Stalker's Dream'*, DAILY MAIL (Mar. 1, 2010, 1:02 PM), <http://www.dailymail.co.uk/news/article-1254537/Facial-recognition-phone-application-described-stalkers-dream.html>. It is currently being used to screen passengers in British airports. Owen Bowcott, *Face Scans for Air Passengers to Begin in UK This Summer*, GUARDIAN (Apr. 24, 2008, 8:00 PM), <http://www.guardian.co.uk/business/2008/apr/25/theairlineindustry.transport>.

²⁶ But see Grant Fredericks, *Can Video Evidence Be Trusted?*, EVIDENCE TECH. MAG., May–June 2010, at 10, 10–14 (explaining why "video can no longer be accepted at face value"). In fact, skepticism is growing in Great Britain as to whether pervasive recording actually does either deter crime or make it easier to solve. See *id.* One reason for this is that like all other forensic evidence recordings produced by CCTV cameras need to be interpreted by experts. *Id.*

²⁷ See Adina Roskies, *Neuroscientific Challenges to Free Will and Responsibility*, 10 TRENDS IN COGNITIVE SCIS. 419, 420 (2006).

²⁸ AM. PSYCHOLOGICAL ASS'N, FUNCTIONAL MAGNETIC RESONANCE IMAGING: A NEW RESEARCH TOOL 6 (2007).

²⁹ E.g., George J. Annas, *Forward: Imagining a New Era of Neuroimaging, Neuroethics, and Neurolaw*, 33 AM. J.L. & MED. 163, 167 (2007). In an introduction to a symposium issue on brain imaging and the law conducted by the *American Journal of Law & Medicine*, an issue frequently cited in this Article, Professor George Annas identified specifically, in

Technology based on neuroimaging is being offered to the legal system as a way of providing investigators³⁰ and juries³¹ direct access to the minds of witnesses. In the short term, this access purports to assess credibility and in the long term to extract information.³² The claims of direct access to the human mind have excited those involved in law enforcement and the justice system who seek to avoid the

the context of footage of Terri Schiavo appearing to smile, that “[i]t is . . . the immediacy and seeming infallibility of pictures that make them simultaneously valuable and dangerous” which many contributors to the symposium issue identified as why brain imaging technology had the particular potential to “provide vivid and compelling, but simultaneously misleading, information.” *Id.* (citing Laura Khoshbin & Shahram Khosbin, *Imaging the Mind, Minding the Image—An Historical Introduction to Brain Imaging and the Law*, 33 AM. J.L. & MED. 171 (2007); and then citing Joseph Baskin et al., *A Picture is Worth a Thousand Words: The Role of Neuroimaging in the Courts*, 33 AM. J.L. & MED. 239 (2007)).

³⁰ The “identification” claims being made for fMRI are based on the premise that there were consistent patterns of brain activity when a person sees something they recognize. Thus, investigators could tell if an individual had ever been to a particular place or seen a person or object. *See infra* Part II.B (discussing limitations of this matching). The other claim is that like fingerprints, each brain has unique features which can establish identity. *See generally* JONATHAN D. MORENO, *MIND WARS: BRAIN RESEARCH AND NATIONAL DEFENSE* (2006).

³¹ *See Customers – Lawyers*, NO LIE MRI, <http://www.noliemri.com/customers/Lawyers.htm> (last visited Feb. 10, 2016) (“The purpose of the justice system is to find the truth. No Lie MRI test results could be used in a similar manner to DNA testing by adding the verification of an individual’s mental record. It would also potentially be possible for a witness to validate his or her own statements to the court.”); *Customers – Government*, NO LIE MRI, <http://www.noliemri.com/customers/Government.htm> (last visited Feb. 10, 2016) (The website explains how its technology would be of benefit to foreign governments, its promotional website states that “[f]or developing countries where government corruption is a serious problem, accurate lie detection would be of tremendous benefit for rooting out corrupt individuals. This would enable trust to be placed in the governmental and economic systems of these countries, encourage greater foreign capital investments to be made, and thus spur modernization of these countries.”).

³² *See* JOHN MEDINA, *BRAIN RULES: 12 PRINCIPLES FOR SURVIVING AND THRIVING AT WORK, HOME, AND SCHOOL* 67 (2008). John Medina in his accessible account of current research based knowledge of how the human brain functions describes a neurosurgeon spending up to three hours before every operation “mapping” the location of functions like speech or motor function in each individual patient because “no two brains are wired identically.” *Id.* at 65. He continues to explain that this kind of research done by stimulating specific points on a person’s brain while he is awake has resulted in a finding that each of our brains has a specific neuron that corresponds to specific memories or experiences we have had. *Id.* at 65–66. This finding led to the much publicized finding that for one subject one specific neuron responded only, and reliably, to a picture of Halle Berry, another to a picture of Jennifer Aniston, and another to Bill Clinton. *Id.* at 60–62. The import of these findings are that for that individual, the firing of that specific neuron was an indication that he was thinking about one of these people. *Id.* at 61–62. Therefore, it is impossible on an individual basis to create a brain map that would be able to identify what a person is thinking at a specific time. *Id.* at 61.

uncertainties of human efforts to distinguish truth-telling from lying.³³ Unfortunately, the same scientists making these claims stand to benefit directly from substantial licensing fees if this technology is adopted in U.S. courts.³⁴

Additionally, one of the core difficulties with using any method of lie detection is the lack of a common definition of “lying.”³⁵ As explained below, what neuroimaging technology is really doing is not so much detecting lying as it is accessing the memory of past events.

³³ See, e.g., Note, *Admitting Doubt: A New Standard for Scientific Evidence*, 123 HARV. L. REV. 2021, 2029–30 & n.57 (2010) (citing Frederick Schauer, *Can Bad Science Be Good Evidence? Lie Detection, Neuroscience, and the Mistaken Conflation of Legal and Scientific Norms*, 95 CORNELL L. REV. 1191 (2010)). The Note described Schauer as “stating that juror assessment of witness testimony uses ‘alleged indicators of veracity [that] are at best highly unreliable, and at worst totally random,’ and arguing that this context makes it plausible that fMRI evidence, while far from perfect, could nevertheless increase accuracy.” *Id.* at 2030 n.57 (alteration in original) (citation omitted).

³⁴ Adi Narayan, *The fMRI Brain Scan: A Better Lie Detector?*, TIME (July 20, 2009), <http://content.time.com/time/health/article/0,8599,1911546-1,00.html>. Asked about the potential value of a technology that could reliably identify deception, Stanford Professor Hank Greely, the leading legal scholar writing on fMRI technology as a truth-testing machine, told *Time Magazine* “that if fMRI lie detection became admissible in court, the industry could easily be worth more than a billion dollars per year.” *Id.* Although he does not believe that the technology is sufficiently developed he explains that the potential pay off makes it worthwhile for the companies to keep trying to get fMRI evidence admitted. See *id.* He said, “It’s a big country, there are lots of judges out there and I think they are hoping to find one who will allow the evidence, particularly if the other side doesn’t know much To be able to use [fMRI lie detection] in court would be the blue ribbon, the license to print money.” *Id.* (second alteration in original).

³⁵ DAVID A. HARRIS, *FAILED EVIDENCE: WHY LAW ENFORCEMENT RESISTS SCIENCE* 43 (2012). “[P]rofessor Richard Leo explains, ‘no physiological or psychological response unique to lying (and never present in truthfulness) has ever been discovered.’” *Id.* “Thus, the theory of the Behavior Analysis Interview remains implausible, especially vulnerable to interpreter bias, and open to doubts about its validity and false positives.” *Id.* (commenting on the admissibility of a police interrogation technique called the “Behavior Analysis Interview”). The marketers of Behavior Analysis Interview advertise it as being “a non-accusatory interview designed to identify whether or not a person is telling the truth or withholding relevant information concerning a specific crime or act of wrongdoing. The interview has proven to be very effective when there are many possible suspects and no evidence pointing to a particular person.” *Behavior Analysis Interview*, JOHN E. REID & ASSOCS., INC., https://www.reid.com/services/r_behavior.html (last visited Feb. 10, 2016). The Reid Institute advertises that it has developed an interview technique which “permit[s] evaluation of a person’s truthfulness independent from a polygraph examination.” *Critics Corner: The Reid Technique*, *supra* note 15.

To know that one actually committed a crime that one is denying, it is necessary to remember that event.³⁶

A. The Current State of Neuroimaging Technology in U.S. Courts

There is, so far, no documented case of neuroimaging evidence being accepted as evidence in a U.S. courtroom for the purpose of assessing the truthfulness of the witness's testimony. However, neuroimaging evidence is a familiar technology in criminal courts where brain scans are admitted to support diagnoses of mental illness or impairment.³⁷ Nevertheless, a court in Brooklyn, New York, specifically rejected the introduction of the results of an fMRI scan because it was offered "to show that a witness . . . was telling the truth about the details of the case."³⁸

Although its use has been limited in U.S. courts, there is increasing anecdotal evidence of information from neuroimaging scans used as a tool for truth verification in overseas courts.³⁹ In India, for example, there were three murder trials where neuroimaging scans were used, and in all three the defendants were convicted.⁴⁰

³⁶ See generally LUDWIG WITTGENSTEIN, *PHILOSOPHICAL INVESTIGATIONS* (P.M.S. Hacker & Joachim Schulte eds., G.E.M. Anscombe et al. trans., John Wiley & Sons Ltd. 4th ed. 2009) (1953).

³⁷ See Aaron Saenz, *fMRI Used as Evidence in Sentencing for Murderer*, SINGULARITYHUB (Dec. 2, 2009), <http://singularityhub.com/2009/12/02/fmri-used-as-evidence-in-sentencing-for-murderer>. Whether neuroimaging evidence should be used for the purpose is beyond the scope of this Article. Its diagnostic uses depend on an underlying conclusion that it is possible to diagnose mental illness by looking at a living brain. For a thoughtful review of how courts have analyzed the admissibility of PET and SPECT methodology, see Neal Feigenson, *Brain Imaging and Courtroom Evidence: On the Admissibility and Persuasiveness of fMRI*, 2 INT'L J.L. CONTEXT 233 (2006). For a discussion on the way different kinds of neuroimaging have been used to make claims about mental health or mental disability, see Jane Campbell Moriarty, *Flickering Admissibility: Neuroimaging Evidence in the U.S. Courts*, 26 BEHAV. SCI. & L. 29 (2008).

³⁸ Alexis Madrigal, *Brain Scan Evidence Rejected by Brooklyn Court*, WIRED (May 5, 2010, 5:08 PM), <http://www.wired.com/2010/05/fmri-in-court-update/> (discussing *Wilson v. Corestaff Servs. L.P.*, 900 N.Y.S.2d 639 (Sup. Ct. 2010)); see also Aaron Saenz, *Another Attempt to Use fMRI Lie Detector in US Court Fails in Brooklyn. More on the Way.*, SINGULARITYHUB (May 6, 2010), <http://singularityhub.com/2010/05/06/another-attempt-to-use-fmri-lie-detector-in-us-court-fails-in-brooklyn-more-on-the-way/>.

³⁹ Julie Seaman, *Black Boxes: fMRI Lie Detection and the Role of the Jury*, 42 AKRON L. REV. 931, 933 (2009) (discussing implications of a foolproof lie detector in the context of the jury's role).

⁴⁰ See Anand Giridharadas, *India's Novel Use of Brain Scans in Courts is Debated*, N.Y. TIMES (Sept. 14, 2008), <http://www.nytimes.com/2008/09/15/world/asia/15brainscan.html?pagewanted=all>.

B. How Does Neuroimaging Work?

The fMRI was developed to conduct the same kind of medical diagnostic testing as conventional magnetic resonance imaging (MRI) and has also been used to diagnose brain injuries and, more controversially, even mental illness.⁴¹ However, fMRI's ability to capture real-time information⁴² of brain activity in order to draw conclusions about the origins of human behavior has caught the attention of a wide range of social science researchers studying buying habits⁴³ and investing.⁴⁴ One of the companies selling fMRI technology for use in the courtroom claims that it “provides unbiased methods for the detection of deception and other information stored in the brain.”⁴⁵ No Lie MRI's promotional material explains that the technology does so by “[b]ypass[ing] conscious cognitive processing” and “represents the first and only direct measure of truth verification and lie detection in human history.”⁴⁶ This statement goes far beyond any made by scientists in any peer-reviewed publication. Indeed, the basic criticism of fMRI technology as a method of reading thoughts is that there is disagreement among scientists as to what is actually recorded.⁴⁷ No one claims to actually observe the direct action of neurons as they fire. To compound the difficulty, there is no generally agreed upon definition of “thought,” let alone a theory on its

⁴¹ See Oguz Demirci et al., *A Review of Challenges in the Use of fMRI for Disease Classification / Characterization and A Projection Pursuit Application from Multi-site fMRI Schizophrenia Study*, 2 BRAIN IMAGING & BEHAV. 147, 147 (2008) (“There is much hope that fMRI data can be used to characterize and/or classify brain disorders such as Alzheimer's disease, schizophrenia, mild traumatic brain injury, addiction or bipolar disorder using the biologically measured quantity.”); Doron Gothelf et al., *The Contribution of Novel Brain Imaging Techniques to Understanding the Neurobiology of Mental Retardation and Developmental Disabilities*, 11 MENTAL RETARDATION & DEVELOPMENTAL DISABILITIES RES. REVS. 331, 337 (2005) (describing the difficulties with using fMRI for the mentally retarded); Sean Kevin Thompson, *A Brave New World of Interrogation Jurisprudence?*, 33 AM. J.L. & MED. 341, 341–42 (2007).

⁴² Bradley P. Sutton et al., *Current Trends and Challenges in MRI Acquisitions to Investigate Brain Function*, 73 INT'L J. PSYCHOPHYSIOLOGY 33, 33 (2009).

⁴³ See, e.g., Gerhard Raab et al., *A Neurological Study of Compulsive Buying Behaviour*, 34 J. CONSUMER POL'Y 401, 401 (2011).

⁴⁴ See, e.g., Richard L. Peterson, *The Neuroscience of Investing: fMRI of the Reward System*, 67 BRAIN RES. BULL. 391, 391 (2005).

⁴⁵ NO LIE MRI, *supra* note 8.

⁴⁶ *Id.*

⁴⁷ See D.D. Langleben et al., *Brain Activity During Simulated Deception: An Event-Related Functional Magnetic Resonance Study*, 15 NEUROIMAGE 727, 727 (2002).

physiological basis.⁴⁸ Researchers making claims for fMRI believe that blood flows to the part of the brain required to address a specific task. Under this construct, it is possible to identify the part of the brain engaged in an activity by measuring blood flow.⁴⁹ For example, when a person speaks, blood flows to the part of the brain associated with speaking. The basic task of fMRI research, then, is to give human subjects specific tasks, such as to think about someone you love, and measure where the blood goes.⁵⁰

The inventor of the process now used for analyzing these readings, Lawrence Farwell, made the comparatively modest claim that brain activity was unique to each individual and that these scans could be used as a tool for identification, labeling it “brain fingerprinting.”⁵¹ Like fingerprint analysis, analysis of brain imaging data is a process of finding unique patterns that can be used to identify each individual.⁵² Farwell’s brain fingerprinting, however, goes far beyond confirming identity. He claims that a specific pattern of brain activity can be correlated with having a memory of a specific location or incident.⁵³ In that way, it does not detect lying at all. Rather, it detects information stored in the brain. If someone has committed a crime, they have a record of that in their brain, and the probe can detect if they have the details of a specific crime stored in their mind.⁵⁴ The idea of using the technology to detect lies is based on the results of experiments that show recognizable and consistent patterns among subjects who are

⁴⁸ Leroy Cronin et al., *The Imitation Game—A Computational Chemical Approach to Recognizing Life*, 24 NATURE BIOTECHNOLOGY 1203, 1204 (2006).

⁴⁹ See Daniel D. Langleben et al., *True Lies: Delusions and Lie-Detection Technology*, 34 J. PSYCHIATRY & L. 351, 357 (2006) (“Since deception is a cognitive phenomenon that takes place in the brain, the potential of the [measurement of blood pressure, skin conductance, heart rate, and breathing] in a lie-detection system is theoretically inferior to the more proximal, central nervous system (CNS) correlates of brain activity that could be obtained by EEG and fMRI.”).

⁵⁰ See Archie Alexander, *Functional Magnetic Resonance Imaging Lie Detection: Is a “Brainstorm” Heading Toward the “Gatekeeper”?*, 7 HOUS. J. HEALTH L. & POL’Y 1, 36 (2007); Teneille Brown & Emily Murphy, *Through a Scanner Darkly: Functional Neuroimaging as Evidence of a Criminal Defendant’s Past Mental States*, 62 STAN. L. REV. 1119, 1138–39 (2010).

⁵¹ Polly Shulman, *Liar Liar Pants on Fire*, POPULAR SCI. (July 24, 2002), <http://www.popsci.com/scitech/article/2002-07/liar-liar-pants-fire> (recounting the history of 1991 experiments done by Farwell and his then advisor Emanuel Donchin that identified patterns in brain responses to familiar objects embedded among unfamiliar ones).

⁵² See *id.*

⁵³ See Lawrence A. Farwell et al., *Farwell Brain Fingerprinting in the Case of Harrington v. State*, BRAINWAVE SCI. 7, 7, http://www.brainwavescience.com/Farwell_Brain_Fingerprinting_in_Harrington_v_State.pdf (last visited Feb. 10, 2016).

⁵⁴ See *id.* at 8.

asked to engage in deliberate deception—such as misidentifying a card they are holding.⁵⁵

Many people are involved in the process of using neuroimaging for the courtroom. First, just as a crime scene technician must be trained to retrieve blood samples without contaminating them, neuroimaging data cannot be obtained without a trained technician actually operating the scanning equipment.⁵⁶ This aspect of neuroimaging is no different from what would be required for anyone undergoing diagnostic testing. However, for forensic purposes, it is not enough to merely operate the scanning equipment. In the case of fMRI data, the digital recording, which are called pulses, must first be entered into a computer and then analyzed by software which matches the location of blood flow with predetermined maps of the brain’s areas of specialization.⁵⁷ It can then be matched to a timed transcript of an interrogation to create a record of what happened when the subject was asked a specific question.⁵⁸ Those findings are then interpreted by a cognitive scientist.⁵⁹ So, if after many experiments, it turns out that every time a person lies, blood flows to one particular area, software analyzing fMRI data can identify blood flow to that area in future scans as evidence of lying.⁶⁰

The software used to analyze and interpret neuroimaging data is mathematically complex as well as proprietary.⁶¹ In order to enter evidence of conclusions about veracity based on this data, the

⁵⁵ See Jane Campbell Moriarty, *Visions of Deception: Neuroimages and the Search for Truth*, 42 AKRON L. REV. 739, 740 n.2 (2009). One of the most difficult tasks in discussing “deception” is defining it. Writing about the Neuroscience, Law & Government Symposium held in 2008 at the University of Akron, Professor Jane Campbell Moriarty explains that “adequately defining the concept of deception is more complicated and outcome-determining than one might imagine: is it uttering false words, responding misleadingly to requests to push one button or another, or simply attempting to think untrue thoughts on demand?” *Id.* at 740. She goes on to suggest that in order to effectively address the use of neuroimaging in the courts, “perhaps another focus needs to be not on deception, but on what we mean by truth.” *Id.*

⁵⁶ Matt A. Bernstein, How to do a STRUCTURAL Multicenter Neuroimaging Study 2, http://cds.ismrm.org/protected/09MProceedings/files/Mon%20C35_02%20Bernstein.pdf (unpublished class materials, Mayo Clinic, Rochester, MN) (last visited Feb. 10, 2016).

⁵⁷ *Id.* at 1.

⁵⁸ Steve Silberman, *Don’t Even Think About Lying*, WIRED (Jan. 1, 2006, 12:00 PM), <http://www.wired.com/2006/01/lying/>.

⁵⁹ See *id.*

⁶⁰ See Brown & Murphy, *supra* note 50, at 1138–39.

⁶¹ See, e.g., Benjamin Martin Bly et al., *The RUMBA Software: Tools for Neuroimaging Data Analysis*, 2 NEUROINFORMATICS 71, 71 (2004).

proponent would have to offer it through expert testimony.⁶² Every step in the process adds additional expense so that it is unlikely that the defense in a criminal trial could afford to either run their own test or even hire their own expert to review the conclusions drawn by the State's expert.⁶³

What this software does, moreover, is far different and more subjective than image-enhancing software, for example, which allows greater resolution from digital pictures by employing mathematical formulas.⁶⁴ It seems as though the task for the software developer would be to create a program to analyze the frequency with which certain behaviors, such as deception or non-deception, correlate to externally confirmable facts. To do that, she must study the results of research experiments in which subjects are induced to lie while their brains are being scanned. For the software to have any value, it must find an identifiable digital signal that occurs every time someone lies.

There is nothing unusual about analyzing evidence collected at a crime scene using pattern recognition. But whether the testing process involves analysis of data or matching of dental records, what is presented to the jury is usually an expert's interpretation of the analysis, not the data itself.⁶⁵ There are two major concerns with all forensic tests. First, there is no reason to believe that what fMRI scans measure while a person is engaged in a specific behavior is attributable to the act of deliberate deception.⁶⁶

Second, cognitive scientists and mathematicians must work together in order to establish parameters for reaching their conclusions;⁶⁷ specifically, they must define what constitutes deception and assign it

⁶² See *United States v. Semrau*, 693 F.3d 510, 523 (6th Cir. 2012) (holding that expert testimony regarding fMRI evidence was properly excluded under Federal Rule of Evidence 702).

⁶³ For a general overview of the wide repercussions of under-funding the public defense system, see KATE TAYLOR, JUSTICE POLICY INST., *SYSTEM OVERLOAD: THE COSTS OF UNDER-RESOURCING PUBLIC DEFENSE* (July 2011).

⁶⁴ See Brown & Murphy, *supra* note 50, at 1138–43.

⁶⁵ See Adam Deitch, Comment, *An Inconvenient Tooth: Forensic Odontology Is an Inadmissible Junk Science When It Is Used to "Match" Teeth to Bitemarks in Skin*, 2009 WIS. L. REV. 1205, 1232–33 (explaining why bitemark testimony is not reliable but is still harmful because bitemark-matching testimony, like polygraph evidence, is "draped in an 'aura of scientific precision and objective measurement'" (quoting *State v. Dean*, 307 N.W.2d 628, 633 (Wis. 1981))).

⁶⁶ See Brown & Murphy, *supra* note 50, at 1160–63.

⁶⁷ See generally Daniel Andler, *Mathematics in Cognitive Science*, in *PROBABILITIES, LAWS, AND STRUCTURES* 363 (Dennis Dieks et al. eds., 2012).

a value.⁶⁸ The problem is that each scan generates a tremendous amount of data.⁶⁹ As a recent paper explained, there is often so much data generated that it overwhelms the software intended to recognize patterns that indicate deception.⁷⁰

C. The Lure of Truth-Verification Technology

Analysis of data obtained by fMRI machines has captured the imagination of the popular press. The magazine *Popular Mechanics* has already adopted the definition of neuroimaging as a mind-reading process by describing a scientist watching the results of an experiment as “peering into another man’s mind.”⁷¹ It is just this kind of rhetoric that leads people to believe neuroimaging is a useful tool for the courtroom.

Despite No Lie’s claims about the technology’s role in overturning a conviction in Iowa, it has not yet actually been presented directly to a court that then used the results as the basis of a decision.⁷² Unlike the

⁶⁸ See Karuna Meda, *fMRI Lie Detection: Is There Science Behind Deception?*, J. YOUNG INVESTIGATORS (Sept. 2009), <http://www.jyi.org/issue/fmri-lie-detection-is-there-science-behind-deception/> (“[T]he fMRI does not measure two important components of lying- the emotional response and the intention of the liar’ [sic] to instill false belief in another person.”).

⁶⁹ Bo Jin et al., *Feature Selection for fMRI-based Deception Detection*, BMC BIOINFORMATICS 2–3 (Sept. 17, 2009), <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2745686/pdf/1471-2105-10-S9-S15.pdf>.

⁷⁰ See *id.* at 2 (identifying one of the first steps in developing algorithms to correlate deception with specific brain activity was to find a way of selecting a limited sample of the data that still resulted in a high rate of successfully detecting deception).

⁷¹ Jeff Wise, *Thought Police: How Brain Scans Could Invade Your Private Life*, POPULAR MECHANICS (Oct. 14, 2007, 8:00 PM), <http://www.popularmechanics.com/science/health/neuroscience/4226614>.

⁷² But see Brain Fingerprinting Labs., Inc., *Iowa Supreme Court Reverses Harrington Murder Conviction After 24 Years*, PR NEWswire (Feb. 26, 2003), <http://www.prnewswire.com/news-releases/iowa-supreme-court-reverses-harrington-murder-conviction-after-24-years-74496007.html>. Brain Fingerprinting Laboratories (BFL), owned and operated by Dr. Lawrence Farwell, claims not only that his technology has already been admitted into court for the purpose of verifying the testimony of a man wrongfully accused of murder, but that it was the basis of a decision by the Iowa Supreme Court to overturn the man’s conviction. *Id.* The reality is less dramatic. The headline of BFL’s press release is dramatic, “Iowa Supreme Court Reverses Harrington Murder Conviction after 24 Years,” *id.*, but not entirely accurate if the suggestion is that the defendant was freed based on brain fingerprinting. Although the Iowa Supreme Court did overturn the wrongful conviction, it did not do so based on the information from Dr. Farwell’s brain fingerprinting. See *Harrington v. State*, 659 N.W.2d 509, 525 (Iowa 2003). Moreover, the question of whether or not the trial court

scientists and businessmen who tout the brain imaging technology in its current state of development as ready for courtroom use, scholars in law and ethics are far more cautious.⁷³ From the earliest calls for caution by Hank Greely to the more nuanced criticisms of why the current data is insufficient to support any claims of reliability, many academics have expressed their doubts and concerns.⁷⁴

The criticism takes several forms; some is purely concerned with the fact that the findings are based on the current technology subject to substantial limitations.⁷⁵ Other critics question the constitutionality of forcing an individual to involuntarily incriminate himself.⁷⁶

Nikos Logothetis issued a forceful call for caution in the journal *Nature* after claiming that his data collected from brain scans done on monkeys had been stolen and misinterpreted by two former graduate-student laboratory assistants to indicate that neuroimaging could accurately identify human deception.⁷⁷ Logothetis wrote that:

should have allowed the brain fingerprinting information into evidence was not an issue before the court. *See id.* at 512.

⁷³ *See* Brown & Murphy, *supra* note 50, at 1134–35 (arguing that fMRI has not yet shown the level of reliability necessary to assess the state of mind of a criminal defendant at the time of the crime); Brian Reese, Comment, *Using fMRI as a Lie Detector – Are We Lying to Ourselves?*, 19 ALB. L.J. SCI. & TECH. 205, 223–24 (2009). Brian Reese emphasizes that even if the existing studies could be interpreted to detect deception at an acceptable rate, there are so many different sub-populations on which it has not been tested as to make its use completely unacceptable. *See id.* at 219–26.

⁷⁴ *See, e.g.*, Brown & Murphy, *supra* note 50, at 1206 (“[U]ntil fMRI is able to reliably capture past mental states, this evidence should not be admissible for such purposes either under FRE 403 or under local standards for admissibility of scientific evidence.”).

⁷⁵ *See* George M. Dery, *Lying Eyes: Constitutional Implications of New Thermal Imaging Lie Detection Technology*, 31 AM. J. CRIM. L. 217, 242–49 (2004) (weighing the constitutional concerns raised by thermal lie detectors); Laurence R. Tancredi & Jonathan D. Brodie, *The Brain and Behavior: Limitations in the Legal Use of Functional Magnetic Resonance Imaging*, 33 AM. J.L. & MED. 271, 286–91 (2007) (discussing the inappropriateness of fMRI to establish a causal connection).

⁷⁶ *See* Dov Fox, *The Right to Silence as Protecting Mental Control*, 42 AKRON L. REV. 763, 763–64 (2009) (examining the idea that individuals have a moral and constitutional right of control over the use of their own thoughts); Stoller & Wolpe, *supra* note 11, at 375 (evaluating whether neurotechnological lie detection is likely to be covered under the Fifth Amendment privilege). *But see* Michael S. Pardo, *Neuroscience Evidence, Legal Culture, and Criminal Procedure*, 33 AM. J. CRIM. L. 301, 305 (2006) (“[T]here is nothing uniquely problematic about the proposed neuroscience evidence, and that its compelled production falls within core concepts and doctrines of both the Fourth Amendment and the Self-Incrimination Clause . . .”).

⁷⁷ Alison Abbott, *Neuroscientist: My Data Published Without Authorization are ‘Misleading,’* NATURE (July 2, 2008), <http://www.nature.com/news/2008/080702/full/454006a.html>.

The limitations of fMRI are not related to physics or poor engineering, and are unlikely to be resolved by increasing the sophistication and power of the scanners; they are instead due to the circuitry and functional organization of the brain, as well as to inappropriate experimental protocols that ignore this organization.⁷⁸

Commenting on his Logothetis’s gloomy prediction, Jonah Lehrer, a highly successful poplizer of science, translated the words from science to plain English:

Although brain scanner technology is often described as a “window into the brain,” Logothetis, in this most recent article, makes it clear that the metaphor of transparency is inappropriate. He cites a long list of factors that complicate the interpretation of fMRI data, from the challenge of distinguishing between excitation and inhibition to the difficulty of measuring the relative activation of different brain areas.⁷⁹

Lehrer concluded by warning, “[i]f brain scanners are like a window, then the window has some very dirty glass.”⁸⁰

There are two kinds of claims made for using brain imaging software, one relatively narrow and one quite broad. The narrow claim now being made by the companies marketing this technology is that it can, with greater accuracy than a polygraph machine, assess in real-time whether an individual answering questions is providing truthful information.⁸¹ Specifically, one company claims, “The technology used by No Lie MRI represents the first and only direct measure of truth verification and lie detection in human history!”⁸²

The broader claim goes beyond evaluating veracity to actually reading thoughts. As one article describes it, “Soon, the technology could go even further, pulling back the curtain guarding our most private selves. Indeed, boosters say, a nearly foolproof lie detector based on brain scanning is just around the corner.”⁸³

Scientific literature has only one common point of agreement when discussing a correlation between fMRI results and specific thoughts or emotions: much more experimenting needs to be done before

⁷⁸ Jonah Lehrer, *Science, Criticism, fMRI*, SCIENCEBLOGS: THE FRONTAL CORTEX (June 24, 2008), <http://scienceblogs.com/cortex/2008/06/24/science-criticism-fmri/>.

⁷⁹ *Id.*

⁸⁰ *Id.*

⁸¹ See, e.g., NO LIE MRI, *supra* note 8.

⁸² *Id.*

⁸³ Wise, *supra* note 71.

concluding that that it is possible to reliably identify specific thoughts.⁸⁴ In addition, the test subjects tend to be the usual subjects of scientific study—college students who are unlikely to match the population of criminal defendants on whom this technology would someday be used.⁸⁵ The last, and very serious, criticism is that I believe that the data now available was obtained under ideal laboratory conditions and may therefore be inapplicable when the subject is someone actually being accused of a crime. As in any medical scan, the subject must lay still for the length of the interrogation.⁸⁶ Although this could be stressful for anyone, there is no baseline for its effect on criminal defendants.

While these studies are beyond the scope of this Article because they look to explain or predict human behavior but do not seek to impose prison sentences on those scanned, the criticisms they have engendered for overstating their results are relevant to an understanding of fMRI's reliability as a lie detector.⁸⁷ In fact, scientists do not know what about the brain makes magnetic energy react as it does, nor do they claim to

⁸⁴ See, e.g., Tancredi & Brodie, *supra* note 75, at 293–94 (reviewing the claims made as to the ability to diagnose mental disability using fMRI technology from a psychiatric perspective and pointing out the technology's limits as a reliable method of predicting future behavior).

⁸⁵ For example, the prestigious magazine *Science* reported that a federal magistrate judge in Tennessee rejected the introduction of fMRI evidence by the defendant who was indicted for making three million dollars in false Medicaid and Medicare billings. Greg Miller, *fMRI Lie Detection Fails a Legal Test*, 328 SCIENCE 1336, 1336 (2010). The defendant wanted to introduce the fMRI evidence to show he had no intent of defrauding the government. Greg Miller, *Can Brain Scans Detect Lying? Exclusive New Details from Court Hearing*, SCIENCE (May 14, 2010, 12:09PM), <http://news.sciencemag.org/2010/05/can-brain-scans-detect-lying-exclusive-new-details-court-hearing>. Although there is no published opinion, the magistrate issued a twenty-nine page report and *Science* published an account by a cognitive scientist who attended the hearing. See *id.* (interviewing cognitive neuroscientist Martha Farah). Marcus Raichle, a neuroimaging expert who testified, noted that among the evidence heard by the judge was that the findings on the defendant were not reliable because the defendant was “in his 60s when the scans were taken, considerably older than the 18- to 50-year-old subjects who participated in the published studies.” *Id.*

⁸⁶ See Reese, *supra* note 73, at 223 (“Detecting deception through the use of fMRI will also prove difficult in people who have suffered some sort of brain injury during their lifetime. There are two ways that this type of damage can occur: physical trauma or mental/emotional trauma.”). The issue is not just one of willingness to lay still and subject one's mind to magnetic pulses, but also the ability to do so. Brian Reese does an excellent job of surveying the populations who could not be candidates for neuroimaging because of their inability to do this. See *id.* at 219–27.

⁸⁷ See, e.g., Edward Vul et al., *Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition*, 4 J. ASS'N PSYCHOL. SCI. 274, 285 (2009).

observe the actual activity of neurons firing in response to events happening outside the body.⁸⁸

Not surprisingly, neuroscientists’ claims for neuroimaging are far more modest than those of the commercial companies trying to sell it. The strongest scientific claim for fMRI is its ability to detect deliberate deception under controlled laboratory conditions.⁸⁹ For example, a research team reported that they were eighty-six percent successful in replicating earlier studies that determined when subjects were being deliberately deceptive.⁹⁰ Since the ability to replicate results is the “gold-standard” of the scientific method, this achievement was important, and I believe that their conclusion that their methodology “is robust” was justified. But so was their cautious conclusion that “this study provides further support for the *feasibility* of using fMRI to detect deception.”⁹¹ Despite this hopeful outlook, no independent scientist or legal scholar has put forward the position that, in its current state of development, contemporary neuroimaging technology is a reliable method of determining whether someone is telling the truth.⁹²

Analyzing fMRI results is based on observing a phenomenon like waves crashing on a beach and deducing its causation. A rough analogy might be throwing stones into a deep well. One can be sure that the noise following each tossed stone is caused by the stone. One can also make very accurate measurements of the time intervals between tossing the stone and hearing the noise. But, this knowledge is not the same as knowing the precise nature of the substance it is hitting. Even if there were a generally accepted understanding of the accuracy and reliability of conclusions drawn from fMRI data, it would either be so negative no one would ever use it, or so deceptive that the famously innumerate American public, jurors, judges, and lawyers could not accurately

⁸⁸ See Brown & Murphy, *supra* note 50, at 1138–39.

⁸⁹ See F. Andrew Kozel et al., *Replication of Functional MRI Detection of Deception*, 2 OPEN FORENSIC SCI. J. 6, 8 (2009).

⁹⁰ *Id.*

⁹¹ *Id.* at 10 (emphasis added).

⁹² See, e.g., WALTER GLANNON, BIOETHICS AND THE BRAIN 63–64 (2007) (warning of the practical limits of fMRI technology and technology’s general tendency to wrongly seduce a member of the public); Jennifer S. Bard, *Learning from Law’s Past: A Call for Caution in Incorporating New Innovations in Neuroscience*, 7 AM. J. BIOETHICS 73, 73 (2007) (calling for caution in rushing into complete reliance on neuroimaging as a tool for investigation or trial); Daniel V. Meegan, *Neuroimaging Techniques for Memory Detection: Scientific, Ethical, and Legal Issues*, 8 AM. J. BIOETHICS 9, 9 (2008) (describing forensic use of neuroimaging as not a lie detector test but rather a memory detection technique).

evaluate the information they were given because of the technology's appeal.

D. Neuroimaging as a Forensic Science

The general term “forensic science” describes techniques to analyze evidence in order to assist juries in the United States reach conclusions about the factual events in cases before them.⁹³ The most commonly used forensic sciences are essentially matching techniques in which fingerprints, bullets, clothing, blood, and other substances found at a crime scene or on a victim are matched with samples taken from the defendant.⁹⁴ Many states define “forensic evidence” more specifically in statutes, which describe what forensic evidence can be admitted and how it must be collected and analyzed.⁹⁵ Conclusions offered to a jury about a witness's veracity that are based on analysis of information collected through neuroimaging fall under this category and thus must be considered as a new type of forensic science.

As a group of noted experts recently explained, the entire field of forensic science is being subject to considerable debate and review.⁹⁶ As they write, “For roughly a hundred years, these comparison and identification methods have regularly and routinely been employed as legal evidence. For most of that period, courts, attorneys, jurors, and the public, as well as forensic analysts themselves, have largely accepted this evidence as trustworthy and uncontroversial.”⁹⁷ However, during the past several years, “the situation has changed dramatically. These methods and techniques now face more criticism and scrutiny than ever before.”⁹⁸

Much of this criticism and scrutiny is represented in a 2009 report by the National Research Council and the National Academy of

⁹³ See *What is Forensic Science?*, AM. ACAD. FORENSIC SCIS., <http://www.aafs.org/students/choosing-a-career/what-is-forensic-science/> (last visited Feb. 10, 2016) (“Any science used for the purposes of the law is a forensic science.” (emphasis omitted)).

⁹⁴ See Jennifer L. Mnookin et al., *The Need For a Research Culture in the Forensic Sciences*, 58 UCLA L. REV. 725, 726 (2011).

⁹⁵ See, e.g., 8 COLO. CODE REGS. § 1507-29 (2015) (“‘Forensic Medical Evidence’ means evidence collected by medical or law enforcement personnel using a sexual assault evidence collection kit (or components thereof) consistent with state/national collection standards.”); N.C. GEN. STAT. § 8-58.20 (2014) (setting forth the “forensic analysis admissible as evidence”); TEX. CODE CRIM. PROC. ANN. art. 38.35(a)(4) (West 2013) (defining “forensic analysis”).

⁹⁶ See Mnookin et al., *supra* note 94, at 725–26.

⁹⁷ *Id.* at 726.

⁹⁸ *Id.* at 727.

Sciences (NAS).⁹⁹ The NAS report reviewed the evidence analysis methods currently in use, outlined the extensive body of criticism that has developed as to their accuracy and reliability, and made substantial recommendations for future reforms.¹⁰⁰ In general, the NAS report found that the evidence being introduced into U.S. courts purporting to offer useful scientific evidence had an inadequate research basis and recommended extensive reforms to how such information should, in the future, be brought before juries.¹⁰¹ Acknowledging that what an fMRI is recording is “not a direct measure of neural activity,” the Oxford Center can only make the relatively weak claim that “fMRI is still a causal step closer to what is happening in the brain than the behavioral correlates psychologists have traditionally depended on.”¹⁰² “Although currently qualitative, [f]MRI is a more objective measure of a person’s mental state than a tick-box questionnaire.”¹⁰³ While perhaps good grounds to keep researching in a promising area, it is hardly a basis for replacing the jury system with a magnetic scanner.

One of the substantial concerns about using neuroimaging data to assist the fact finder in assessing credibility is the risk that the jury will defer to its conclusions rather than exercise independent judgment.¹⁰⁴

⁹⁹ See COMM. ON IDENTIFYING THE NEEDS OF THE FORENSIC SCIS. CMTY., NAT’L RESEARCH COUNCIL, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD (2009) [hereinafter NAS Report].

¹⁰⁰ *Id.* at 14–33.

¹⁰¹ For a current overview of the NAS report and its relation to contemporary forensic practices, see Mnookin, *supra* note 94, at 729; Michael J. Saks et al., *Model Prevention and Remedy of Erroneous Convictions Act*, 33 ARIZ. ST. L.J. 669, 698–702 (2001) (proposing reforms which would reduce bias in the collection, analysis, and presentation of evidence produced by forensic scientific techniques).

¹⁰² *How is FMRI Used?*, NUFFIELD DEP’T CLINICAL NEUROSCIENCES, <http://www.ndcn.ox.ac.uk/divisions/fmrib/what-is-fmri/how-is-fmri-used> (last visited Feb. 10, 2016); see also OXFORD CTR. FOR NEUROETHICS, <http://www.neuroethics.ox.ac.uk/> (last visited Feb. 10, 2016) (“Established in January 2009, The Oxford Centre for Neuroethics aims to address concerns about the effects neuroscience and neurotechnologies will have on various aspects of human life.”).

¹⁰³ *How is FMRI Used?*, *supra* note 102.

¹⁰⁴ See *United States v. Semrau*, 693 F.3d 510, 523–24 (6th Cir. 2012) (reinforcing that under Rule 403, a court may “exclude relevant evidence if its probative value is substantially outweighed by a danger of confusing the issues or misleading the jury . . .”). It is not only the finder of fact who is likely to be unfamiliar with the science at the trial. Lawyers too may find themselves unwilling or, because of time, unable to fully understand the basis of the technologies used by their experts. See Pat A. Wertheim, *Elements of Expert Testimony*, CRIMES & CLUES (Jan. 31, 2013), <http://crimeandclues.com/2013/01/31/elements-of-expert-testimony/>. As Wertheim explains in her article intended to instruct fingerprint examiners how to testify in court,

The human fascination with separating truth from falsehood has a long history.¹⁰⁵

1. Contemporary Law for Admitting Forensic Evidence in the U.S.

Because thought and memory are both human constructs, technology which purports to surpass the jury's own ability to weigh information and testimony can meet neither Federal Rule of Evidence 403's requirement that all evidence presented to a jury be more probative than prejudicial, nor FRE 702, which requires that expert scientific testimony must be reliable.¹⁰⁶

The right to a fair trial is the starting point of legal analysis of forensic evidence admittance in the United States.¹⁰⁷ All evidence rules in U.S. courts must adhere to and uphold the protections granted by the Constitution, which are intended to provide a fair trial.¹⁰⁸ One mechanism for providing a fair trial is the convening of an impartial jury.¹⁰⁹ All the factual determinations are made by the jury based on

Ideally, the calling attorney should follow a logical sequence in asking his questions. In reality, however, he or she may be unfamiliar with your science or with introducing expert testimony. If you cannot have a pretrial conference with the attorney, it helps to go to court with a suggested list of questions. Most attorneys are grateful for the help and will use your questions.

Id.

¹⁰⁵ See generally Paul V. Trovillo, *A History of Lie Detection*, 29 J. CRIM. L. & CRIMINOLOGY 848 (1939).

¹⁰⁶ See FED. R. EVID. 403, 702; Charles Patrick Ewing, *Expert Testimony: Law and Practice*, in 11 HANDBOOK OF PSYCHOLOGY: FORENSIC PSYCHOLOGY 55, 59 (Alan M. Goldstein et al. eds., 2003) (explaining that expert testimony is available for subjects beyond a jury's "ken").

¹⁰⁷ See *United States v. Gonzalez-Lopez*, 548 U.S. 140, 146 (2006) ("The Constitution guarantees a fair trial through the Due Process Clauses, but it defines the basic elements of a fair trial largely through the several provisions of the Sixth Amendment, including the Counsel Clause." (quoting *Strickland v. Washington*, 466 U.S. 668, 684–85 (1984))). The Sixth Amendment provides the following:

In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the State and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and to have the Assistance of Counsel for his defense.

U.S. CONST. amend. VI.

¹⁰⁸ See *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 589 (1993) (construing and applying Rule 702 to mean that a "trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable").

¹⁰⁹ See *Blakely v. Washington*, 542 U.S. 296, 305–06 (2004) (stating that the right to a jury trial "is no mere procedural formality, but a fundamental reservation of power in our constitutional structure. Just as suffrage ensures the people's ultimate control in the

information presented to it in the form of evidence.¹¹⁰ The substance of this evidence is governed by the Federal Rules of Evidence as interpreted by the trial judge. I view the jury’s role in a criminal trial is to come to a collective decision about whether or not the defendant meets the legal standards for being held responsible for the crime with which the State has charged him. They are there to decide the facts, which, in the adversary system, often involves choosing between conflicting opinions of what really happened.¹¹¹ Both the testimony of witnesses with firsthand information and physical objects like weapons constitute evidence. The law recognizes that sometimes the jury needs help in understanding the significance of the evidence it hears.¹¹²

Federal Rule of Evidence 702 therefore allows people with “scientific, technical, or other specialized knowledge” to give the jury their opinion if their testimony “will help the trier of fact to understand the evidence or to determine a fact in issue.”¹¹³ The expert’s role is as an advisor, and the jury does not have to accept his or her opinion as fact.¹¹⁴ Rather, each juror is entitled to make an assessment of the expert’s credibility.¹¹⁵ It is the judge, not either party, who decides whether or not a jury needs assistance; if so, whether the expert offered is qualified to give it; and, if the expert is qualified, whether the basis for the expert’s testimony is reliable.¹¹⁶

legislative and executive branches, jury trial is meant to ensure their control in the judiciary”).

¹¹⁰ *United States v. Wonson*, 28 F. Cas. 745, 750 (C.C.D. Mass. 1812) (No. 16,750) (“Beyond all question, the common law [referred to in the Seventh Amendment] is not the common law of any individual state . . . but it is the common law of England, the grand reservoir of all our jurisprudence.”).

¹¹¹ *Watkins v. Sowders*, 449 U.S. 341, 348 (1981).

¹¹² See Anthony Champagne et al., *Expert Witnesses in the Courts: An Empirical Examination*, 76 JUDICATURE 5, 5 (1992).

¹¹³ FED. R. EVID. 702.

¹¹⁴ See PAUL R. RICE, THE EVIDENCE PROJECT, PROPOSED AMENDMENTS TO EXPERT WITNESS RULES IN THE FEDERAL RULES OF EVIDENCE: RESULTS OF A JUDICIAL SURVEY (1998) (“The rule was premised on the belief that jurors would relegate their independent fact finding role to the expert by accepting his conclusions without independently analyzing their bases or applying the relevant scientific or technological principles.”).

¹¹⁵ *United States v. Cisneros*, 203 F.3d 333, 343 (5th Cir. 2000) (“Credibility determinations are the exclusive province of the jury.”); David E. Seidelson, *Conditional Relevancy and Federal Rule of Evidence 104(b)*, 47 GEO. WASH. L. REV. 1048, 1059 (1979).

¹¹⁶ Harvey Brown, *Eight Gates for Expert Witnesses*, 36 HOUS. L. REV. 743, 744 (1999) (“Rule 702, as well as Rules 401, 403, and 703, place the trial judge in the role of a gatekeeper who bars certain expert evidence.”).

Daubert v. Merrell Dow Pharmaceuticals,¹¹⁷ the first modern case involving the introduction of forensic scientific evidence to reach the U.S. Supreme Court, showed the Court to be well aware of the problems inherent in offering evidence intended to surpass the jury's collective ability to assess credibility.¹¹⁸ Later, when confronted with a request to use the results of a polygraph exam as evidence of a defendant's lack of truthfulness, the Court held in *Frye v. United States* that forensic scientific evidence had to be generally accepted as reliable, and the results of polygraph examinations did not meet this standard.¹¹⁹ What came to be described as the *Frye* standard was the test for admitting forensic scientific evidence in federal courts for the next seventy years, and it is still the test used in many states.¹²⁰

Trial judges' authority has changed due to *Daubert*. Following the Court's decision in *Daubert*, Congress amended FRE 702. It now states:

A witness who is qualified as an expert by knowledge, skill, experience, training, or education, may testify in the form of an opinion or otherwise, if: (a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue; (b) the testimony is based on sufficient facts or data; (c) the testimony is the product of reliable principles and methods; and (d) the expert has reliably applied the principles and methods to the facts of the case.¹²¹

2. How General Criticisms of Forensic Science Today Apply to Neuroimaging Technology

Reviewing the current state of forensic science being offered in U.S. courts, an observer noted, "The nature of science itself, and the fact that

¹¹⁷ *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993).

¹¹⁸ See Daniel D. Blinka, *Why Modern Evidence Law Lacks Credibility*, 58 BUFF. L. REV. 357, 410–11 (2010). This is especially troublesome when the issue before the jury is one of witness credibility. As Blinka notes, "expert opinions on another witness's accuracy are usually of little assistance and only invite the jury to substitute the expert's credibility for that of a lay witness." *Id.* at 417.

¹¹⁹ *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923); see also NORMAN ANSLEY, *ADMISSIBILITY OF POLYGRAPH EVIDENCE IN CRIMINAL AND CIVIL CASES* 1 (1978) (citing *Frye*, 293 F. 1013).

¹²⁰ David E. Bernstein, *Frye, Frye, Again: The Past, Present, and Future of the General Acceptance Test*, 41 JURIMETRICS J. 385, 386 (2001) (describing the history of the *Frye* rule and *Daubert*'s growing influence in *Frye* jurisdictions).

¹²¹ FED. R. EVID. 702; accord *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 147 (1999) (finding that the language concerning "technical" reflects the Court's extension of the *Daubert* standard beyond scientific and medical testimony to "technical testimony" such as that offered by engineers).

forensic science is a service mainly delivered by the government, makes solving its problems a real challenge. Science is complex, constantly in flux, and often subject to disagreement. Government is slow, resistant to change, and difficult to hold accountable.”¹²²

Many have described the years since the Supreme Court’s substantial reworking of the evidentiary standards for admission of expert testimony based on scientific findings as the start of a new era in which judges are taking an active role for the first time in evaluating the techniques and methods on which these experts rely.¹²³ Scholars, such as Professor Margaret Berger, argue that whatever the Court may have originally intended in *Daubert*, these standards are being interpreted by lower federal courts and some state courts, as requiring courts to conduct their own evaluations of scientific techniques presented to them rather than rely on acceptance of the scientific techniques by others in the field.¹²⁴ This new requirement to evaluate scientific evidence on its merits has led to what can be described as a re-evaluation of all forensic evidence, with many traditionally irreproachable or iconic fields, such as fingerprint identification, being revealed as unreliable.¹²⁵ I offer a perhaps fanciful but descriptive analogy: it is as if the public’s faith in forensic science is increasing in proportion to the growing doubts by other stakeholders within the legal system: lawyers and judges. Professors David Caudill and Lewis LaRue contribute to this analysis of what might well be called disenchantment with forensic techniques in their book *No Magic Wand: The Idealization of Science in Law*, in which they describe and criticize society’s overestimation of science’s ability to solve

¹²² JIM FISHER, FORENSICS UNDER FIRE: ARE BAD SCIENCE AND DUELING EXPERTS CORRUPTING CRIMINAL JUSTICE? 275 (2008).

¹²³ See Mara L. Merlino et al., *Meeting the Challenges of the Daubert Trilogy: Refining and Redefining the Reliability of Forensic Evidence*, 43 TULSA L. REV. 417, 417–18 (2007) (surveying steps taken by forensic scientists to “respond[] to the questions about the reliability of their testimony” raised by judges who in response to “the *Daubert* trilogy have imposed more objective, stringent requirements (relevancy, legal sufficiency, and reliability) for the admissibility of some kinds of evidence which for seventy years had been considered admissible under the *Frye* decision’s general acceptance standard . . .”).

¹²⁴ See, e.g., Margaret A. Berger, *The Supreme Court’s Trilogy on the Admissibility of Expert Testimony*, in FED. JUDICIAL CTR., REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 9, 10 (2d ed. 2000).

¹²⁵ See id. at 12; Michael H. Gottesman, *From Barefoot to Daubert to Joiner: Triple Play or Double Error?*, 40 ARIZ. L. REV. 753, 775 (1998); Joseph Sanders et al., *Legal Perceptions of Science and Expert Knowledge*, 8 PSYCHOL. PUB. POL’Y, & L. 139, 143 (2002).

crimes.¹²⁶ This new scrutiny of forensic science can also be described as lifting the curtain on what appeared to be all powerful examiners. What was “behind the curtain” turned out to be much worse than a small man projecting his voice. Worse, further scrutiny revealed that these technicians were not only far from impartial—some were actually deliberately falsifying information in order to induce convictions.¹²⁷

3. *The CSI Effect on Presenting Forensic Evidence at Trial*

Whether it was the Supreme Court’s intent or not, *Daubert* has dramatically changed the process of introducing expert testimony. Many judges now feel obligated to look beyond the general acceptance of a forensic test and ask for information so they can directly assess its reliability.¹²⁸ As a result, long-unquestioned and even iconic technologies are being reexamined and found wanting.¹²⁹ Paradoxically, just as forensic science has come under closer scrutiny by judges, the same forensic science seems to be more trusted by jurors, whose expectations are formed by a string of successful television programs in which forensic science is always available and inevitably infallible.¹³⁰ It is questionable whether the “CSI effect” helps defense attorneys, because it raises juries’ expectations that the prosecution will produce forensic evidence, or the State’s case, because the jury has greater faith in whatever forensic evidence the prosecution does make available. The concerns it has raised, however, speak to the more general perception that juries will be inclined to substitute the testimony of scientific efforts for their own judgment. In terms of

¹²⁶ See generally DAVID S. CAUDILL & LEWIS H. LARUE, NO MAGIC WAND: THE IDEALIZATION OF SCIENCE IN LAW (2006). Their book inspired a substantial response by legal scholars including a symposium sponsored by the Villanova Law Review in 2007. See Symposium, *Expertise in the Courtroom: Scientists and Wizards*, 52 VILL. L. REV. 679 (2007).

¹²⁷ George Castelle, *Lab Fraud: Lessons Learned from the ‘Fred Zain Affair,’* CHAMPION, May 1999, at 12, 12.

¹²⁸ See Sanders et al., *supra* note 125, at 143.

¹²⁹ See Merlino et al., *supra* note 123, at 417–18.

¹³⁰ See Simon A. Cole & Rachel Dioso-Villa, *Investigating the ‘CSI Effect’ Effect: Media and Litigation Crisis in Criminal Law*, 61 STAN. L. REV. 1335, 1340 (2009) (“[S]ome prosecutors have claimed that the *CSI* effect has altered another pillar of the criminal trial—the standard of proof. They have claimed that jurors are now holding them to a *higher* standard of proof than the traditional ‘beyond a reasonable doubt’ standard. In closing arguments, prosecutors have called this higher standard the ‘TV expectation.’” (emphasis in original)).

neuroimaging data, the worry is that juries will believe a machine’s evaluation of a witness’s veracity over their own.¹³¹

One of the central concerns in writing about neuroimaging as a method of lie detection is whether the problem is limitations in the technology or whether it is a larger limitation of the task. To some extent, this Article addresses both by questioning the value to a jury of direct access to a witness’s thoughts. But given how far away neuroimaging is from transcribing thoughts in the way that an EKG is assumed to transcribe heart function, it is more helpful to look at the claims being made for it as a technology rather than at the entire endeavor of separating truth from lies. The difference between lie detecting and other forensic sciences which purport to make matches or analyze chemicals is that the information obtained from neuroimaging purports to distinguish witnesses who are telling the truth from those telling lies in a way that is beyond human ability, just as the microscope extends human ability to see at the molecular level.¹³² No amount of human application or energy can we believe, know beyond a reasonable doubt that someone is lying or certainly know what they are thinking at any specific time.

Presenting such expert testimony to a jury in a U.S. court is a serious challenge to the jury’s essential function as fact finder because it suggests that there is technology superior to the jury’s own ability to evaluate the truthfulness of testimony. Therefore, in a climate where the claims made by all forensic sciences are being subjected to renewed scrutiny and criticism, there is even more reason for caution and concern about adding neuroimaging to the list of forensic sciences routinely offered in U.S. courts.

¹³¹ See Frederick Schauer, *Can Bad Science Be Good Evidence? Neuroscience, Lie Detection, and Beyond*, 95 CORNELL L. REV. 1191, 1210 (2010). Here, there is a strong difference of opinion. Deriding the risk, Schauer writes,

This reliance on juror incompetence to justify excluding neuroscience evidence seems misplaced, however, or, at the very least, premature. . . . [T]he empirical evidence on jury overvaluation is decidedly mixed. Indeed, if we (and the neuroscientists) subjected the common claims of jury overvaluation to the same scrutiny that we subject scientific evidence, we might find that the alleged basis for excluding bad scientific evidence itself rests on less than ideal science.

Id. at 1210–11.

¹³² See, e.g., Karen J. Kelly et al., *The Effect of Deception on Motor Cortex Excitability*, 4 SOC. NEUROSCIENCE 570, 573–74 (2009) (using transcranial magnetic stimulation and finding hemispheric differences in motor cortex excitability where subjects answered deceptively about their favored sports team).

E. Constitutional Implications of Neuroimaging-Based Technologies

Many of the concerns expressed about using fMRI reports at trial are whether they are constitutional.¹³³ Putting aside the practical reality that no such technology exists, scholars argue that a technology which looks into people's brains and reads their thoughts violates the Fourth Amendment's protection against unlawful search or seizure,¹³⁴ and the Fifth Amendment's protection against self-incrimination.¹³⁵

I argue that, additionally, further constitutional rights are at stake in the context of this debate. The U.S. Constitution also grants both civil and criminal litigants the right to a fair trial under the Sixth Amendment's identification of necessary components of a criminal trial,¹³⁶ the Seventh Amendment's identification of necessary components of a civil trial,¹³⁷ and the Fourteenth Amendment's explicit right to a fair trial.¹³⁸ The Seventh Amendment's protections are a rare example of the Constitution's involvement in disputes between two private citizens rather than between an individual and the government. The government takes upon itself the task of hearing private disputes and using state power to enforce judgments. Evidence rules, whether the FRE or those of an individual state, are the means of implementing the right to a fair trial provided in the Sixth and Seventh Amendments to the U.S. Constitution.

¹³³ See generally Christopher Domin, Comment, *Mitigating Evidence? The Admissibility of Polygraph Results in the Penalty Phase of a Capital Trial*, 43 U.C. DAVIS L. REV. 1461 (2010); O. Carter Snead, *Neuroimaging and the "Complexity" of Capital Punishment*, 82 N.Y.U. L. REV. 1265 (2007).

¹³⁴ Benjamin Holley, *It's All in Your Head: Neurotechnological Lie Detection and the Fourth and Fifth Amendments*, 28 DEV. MENTAL HEALTH L. 1, 10–13 (2009) (discussing various forms of neurotechnological lie detection that may be used in criminal investigations in the future and examining situations in which constitutional questions implicated by their potential use, including Fourth and Fifth Amendment considerations).

¹³⁵ Stoller & Wolpe, *supra* note 11, at 364; Erich Taylor, Comment, *A New Wave of Police Interrogation? "Brain Fingerprinting," the Constitutional Privilege Against Self-Incrimination, and Hearsay Jurisprudence*, 2006 U. ILL. J.L. TECH. & POL'Y 287, 312 (questioning whether current legal doctrines would limit the threat of brain fingerprinting and self-incrimination); see also Kiel Brennan-Marquez, *A Modest Defense of Mind Reading*, 15 YALE J.L. & TECH. 214, 248–53 (2013) (defending the constitutionality of mind-reading devices); Pardo, *supra* note 76, at 305.

¹³⁶ U.S. CONST. amend. VI; see also Matthew Baptiste Holloway, Comment, *One Image, One Thousand Incriminating Words: Images of Brain Activity and the Privilege Against Self-Incrimination*, 27 TEMP. J. SCI. TECH. & ENVTL. L. 141, 303–06 (2008) (detailing how information obtained through neuroimaging could violate the Fifth Amendment right against self-incrimination and therefore not be admissible as evidence in court).

¹³⁷ U.S. CONST. amend. VII (protecting the fairness of civil trials).

¹³⁸ U.S. CONST. amend. XIV, § 1.

1. The Confrontation Clause Post-Crawford

Information obtained through analysis of neuroimaging can only reach a jury in a U.S. courtroom if introduced by a scientist qualified to interpret it.¹³⁹ In order to do that, it must meet the requirements of the relevant jurisdiction’s laws of evidence for expert witness testimony or it cannot be offered to the jury as proof of guilt or innocence in a criminal case or liability in a civil one.¹⁴⁰

Juries in the United States hear about forensic evidence through expert testimony.¹⁴¹ Those seeking to introduce scientific evidence must be able to show how it overcomes the deficits courts have identified; it must be information sufficiently reliable as to exceed the jury’s own ability to detect deception.¹⁴²

The Supreme Court’s decision in *Crawford v. Washington* has certainly affected, if not ended, the practice of introducing forensic evidence through a written report rather than requiring the testimony of an expert to interpret the information.¹⁴³ The Supreme Court addressed this attempt to evade *Crawford* when it held that forensic lab reports could not be introduced without the presence of an expert in *Melendez-Diaz v. Massachusetts*.¹⁴⁴ Yet, as the authors of an amicus brief in *Melendez-Diaz* wrote, forensic evidence is still admitted without expert testimony: “the lower courts are in sharp and irreconcilable conflict on this question.”¹⁴⁵

2. Fourth Amendment Concerns

The Fourth Amendment to the Constitution provides that:

¹³⁹ See *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 589–90 (1993).

¹⁴⁰ See FED. R. EVID. 403.

¹⁴¹ See generally Megan J. Erickson, Comment, *Daubert’s Bipolar Treatment of Scientific Expert Testimony—From Frye’s Polygraph to Farwell’s Brain Fingerprinting*, 55 *DRAKE L. REV.* 763 (2007) (reviewing the development of the Supreme Court’s views on expert testimony by first providing an historical explanation of its rejection of polygraph evidence in *Frye* and then predicting how the Court would view neuroimaging evidence which, like polygraphs, purported to surpass the jury’s own ability to assess witness veracity).

¹⁴² See Sanders et al., *supra* note 125, at 142.

¹⁴³ See *Crawford v. Washington*, 541 U.S. 36, 68 (2004).

¹⁴⁴ *Melendez-Diaz v. Massachusetts*, 557 U.S. 305, 311 (2009).

¹⁴⁵ Motion for Leave to File Brief and Brief of Richard D. Friedman as *Amicus Curiae* in Support of Petition for Certiorari at 1, *Melendez-Diaz v. Massachusetts*, 557 U.S. 305 (2009) (No. 07-591), 2007 WL 4287355.

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.¹⁴⁶

The Unreasonable Search or Seizure Clause, as it is often described, would only be implicated if an fMRI scan was performed without an individual's consent after he was arrested. In *Winston v. Lee*, the Supreme Court refused to allow prosecutors to remove a bullet from a defendant's chest, citing the balancing test it established in *Schmerber v. California*.¹⁴⁷ The *Schmerber* test, as explained in *Winston*, requires that the State establish probable cause that the procedure is necessary, and, if so, it must consider "the extent to which the procedure may threaten the safety or health of the individual."¹⁴⁸ Because an fMRI scan does not, as currently understood, pose a danger from exposure to radiation for those experiencing it,¹⁴⁹ the question would be whether being confined in the fMRI machine for the period of the test outweighed the probative value of the information.

Because one of the factors the Court recognized in *Winston* is the probative value of the test itself, the absolute lack of evidence that fMRI scanning can accurately assess the veracity of unwilling participants, or that it can even be effectively conducted on subjects under restraint, would be a strong argument against compelling a defendant to undergo it.

3. Fifth Amendment Concerns

Even if there is a method for obtaining reliable results without the subject's cooperation, it would most likely be inadmissible under the Fifth Amendment.¹⁵⁰ Distinguishing between the admissibility of a blood alcohol level obtained by force and another obtained voluntarily, the Court wrote:

Some tests seemingly directed to obtain 'physical evidence,' for example, lie detector tests measuring changes in body function

¹⁴⁶ U.S. CONST. amend. IV.

¹⁴⁷ *Winston v. Lee*, 470 U.S. 753, 763 (1985) (citing *Schmerber v. California*, 384 U.S. 757 (1966)).

¹⁴⁸ *Id.* at 761 (citing *Schmerber*, 384 U.S. at 771).

¹⁴⁹ In fact, fMRI does not use radiation at all. *fMRI Risks?*, U. MANCHESTER, <http://www.bbmh.manchester.ac.uk/resilience/fMRI/fMRIrisks/> (last visited Feb. 11, 2016).

¹⁵⁰ See U.S. CONST. amend. V. But see Stoller & Wolpe, *supra* note 11, at 364–74 (evaluating whether neurotechnological lie detection is likely to be covered under the Fifth Amendment privilege).

during interrogation, may actually be directed to eliciting responses which are essentially testimonial. To compel a person to submit to testing in which an effort will be made to determine his guilt or innocence on the basis of physiological responses, whether willed or not, is to evoke the spirit and history of the Fifth Amendment.¹⁵¹

F. Why Mind Reading Is an Ineffective Method of Truth Detection

Even if it were possible to directly access memories, the information obtained would be unreliable because it would be filtered through an individual's own character and experiences. It would not, therefore, be a substantial improvement on the current jury system because what we ask of jurors is not a mechanical determination of who is or is not telling the truth, but rather is a holistic scaffold of facts on which to apply the relevant legal standards.

One of neuroimaging's strongest claims is that it can detect “recognition.” But how often would this be useful? In the case of a missing child whose picture has been distributed widely, would recognition by a stranger—let alone someone who knew the child—add anything to the investigation? Would recognizing the face of a notorious terrorist or the President of the United States add anything to an investigation of a potential assassination attempt?

It is dangerous to suggest that memory accessing technology now or ever will replace the role of the jury for two reasons. The first is because, as a practical matter, proof of even the basic claim that there are consistent markers for recognition are based on conditions in a laboratory that can never be reproduced in a courtroom because *Brady v. Maryland* guarantees defendants the right to know about and examine the evidence that will be used against them.¹⁵² Second, even if this fundamental constitutional right did not exist, I can think of very few situations where whether a defendant “recognizes” a piece of evidence or a place is meaningful, let alone dispositive. A local bar where a murder took place could trigger recognition in hundreds of people in the neighborhood. Although law professors in particular are skilled at inventing unlikely scenarios, one where no one but the defendant could recognize a piece of evidence is so rare as to be inconsequential.

¹⁵¹ *Schmerber*, 384 U.S. at 764.

¹⁵² *Brady v. Maryland*, 373 U.S. 83, 87 (1963).

*G. Neuroimaging Versus Eyewitness Testimony: The Limits of
Neuroimaging as a Mind-Reading Technology*

In 1985, Tim Cole was a student at Texas Tech University.¹⁵³ One night while he was buying pizza at a local restaurant, a detective approached him to ask questions.¹⁵⁴ The detective later took a Polaroid picture of Tim Cole at his house.¹⁵⁵ Shortly afterwards, unknown to Tim Cole, the police showed his picture along with five formal booking photos of young African American men to a young woman who had been raped near campus two weeks earlier.¹⁵⁶ Tim Cole's was the only picture where the man was looking into the camera.¹⁵⁷ The account is that she "was immediately sure that Cole was her attacker, saying: 'That's him.'"¹⁵⁸ Even though the rapes on campus continued after Tim Cole's arrest, he was tried for the assault on the victim who identified him and was sentenced to twenty-five years in prison.¹⁵⁹ He died there of complications from an asthma attack in 1999.¹⁶⁰ Moreover, in 1995, after the statute of limitations for the rape expired, another prisoner who had been convicted of similar rapes in the same area wrote a letter to prosecutors claiming he had committed the crimes.¹⁶¹ It was not until Tim Cole's case was taken up by the Innocence Project that he was cleared based on both DNA evidence and the confession. He was posthumously exonerated on April 7, 2009.¹⁶²

What makes Tim Cole's case so different is that the victim, who uses her name in public speeches, has become an advocate for awareness of the dangers of misidentification.¹⁶³ Today, a statue of Tim Cole stands looking at the Texas Tech campus with the inscription "And Justice For

¹⁵³ Timothy Cole, INNOCENCE PROJECT, <http://www.innocenceproject.org/cases-false-imprisonment/timothy-cole> (last visited Feb. 11, 2016).

¹⁵⁴ *Id.*

¹⁵⁵ *Id.*

¹⁵⁶ Sarah Rafique, *Justice System Failed Tim Cole, Victim*, LUBBOCK AVALANCHE-JOURNAL (Sept. 13, 2014, 11:46 PM), <http://lubbockonline.com/local-news/2014-09-13/justice-system-failed-tim-cole-victim>.

¹⁵⁷ Timothy Cole, *supra* note 153.

¹⁵⁸ *Id.*

¹⁵⁹ *Id.*

¹⁶⁰ Rafique, *supra* note 156.

¹⁶¹ *Id.*

¹⁶² Timothy Cole, *supra* note 153.

¹⁶³ *Id.* See generally *The Exonerated and the U.S. Supreme Court*, GEO. L. (Feb. 26, 2009, 12:30 PM), <http://apps.law.georgetown.edu/webcasts/eventDetail.cfm?eventID=721>.

All.”¹⁶⁴ Tim Cole’s case, although more public than most, is not unusual.

The legal community has long been aware of warnings from cognitive psychologists, such as Elizabeth Loftus, that both human thought and memory are constructs of the individual in which they occur.¹⁶⁵ As Yale Law School Professor Steven B. Duke wrote in a 2006 op-ed piece about a different case of wrongful identification, “wrongful imprisonment contains a lesson that has been told and retold thousands of times: Eyewitness identification of strangers is unreliable.”¹⁶⁶ Indeed, this research is often cited to prevent the admission of “recovered memories” from witnesses who have undergone hypnosis or other memory-enhancing techniques.¹⁶⁷ Courts hearing these cases almost routinely find this information unreliable regardless of the witness’s own belief in its veracity.¹⁶⁸ Yet there seems

¹⁶⁴ Betsy Blaney, Associated Press, *Statue of Tim Cole Dedicated in Lubbock*, STAR-TELEGRAM (Fort Worth) (Sept. 17, 2014, 10:20 PM), <http://www.star-telegram.com/news/local/community/fort-worth/article3873738.html>.

¹⁶⁵ See generally ELIZABETH F. LOFTUS, EYEWITNESS TESTIMONY (1996); ELIZABETH LOFTUS, MEMORY: SURPRISING NEW INSIGHTS INTO HOW WE REMEMBER AND WHY WE FORGET (1980); ELIZABETH LOFTUS & KATHERINE KETCHAM, THE MYTH OF REPRESSED MEMORY: FALSE MEMORIES AND ALLEGATIONS OF SEXUAL ABUSE (1994); ELIZABETH LOFTUS & KATHERINE KETCHAM, WITNESS FOR THE DEFENSE: THE ACCUSED, THE EYEWITNESS, AND THE EXPERT WHO PUTS MEMORY ON TRIAL (1991).

¹⁶⁶ Steven B. Duke, *Eyewitness Testimony Doesn’t Make It True*, HARTFORD COURANT (June 11, 2006), http://articles.courant.com/2006-06-11/news/0606120550_1_eyewitness-identification-dna-evidence-dna-analysis.

¹⁶⁷ See *John Doe76C vs. Archdiocese of St. Paul & Minneapolis*, No. 62-C9-06-003962, slip op. at 29–30 (Minn. Dist. Ct. Dec. 9, 2009) (order excluding expert testimony). Judges have routinely refused admission of recovered memory on the grounds that it has not been proved reliable. *E.g.*, *id.* slip op. at 30 (“Plaintiff failed to meet his burden of proof . . . of showing that the theory of repressed and recovered memory is reliable and trustworthy based on well-recognized scientific principles because of the significant methodological flaws in the studies presented by plaintiff in support of that theory and the lack of any test to show reliability.”). There are several advocacy groups organized around opposition to crediting “recovered memory” including the False Memory Syndrome Foundation, to which Elizabeth Loftus is an advisor, whose newsletters serve as compendiums of research, court cases, and articles condemning the movement to recover lost memories. See *About FMFS – Advisory Board Profiles*, FALSE MEMORY SYNDROME FOUND., <http://www.fmsfonline.org/?about=AdvisoryBoardProfiles> (last updated Dec. 13, 2013). See generally *FMFS Newsletter Archive*, FALSE MEMORY SYNDROME FOUND., <http://www.fmsfonline.org/index.php?newsletter=newsletterarchive> (last visited Feb. 11, 2016).

¹⁶⁸ See Michael R. Leippe & Donna Eisenstadt, *Eyewitness Confidence and the Confidence-Accuracy Relationship in Memory for People*, in 2 HANDBOOK OF EYEWITNESS PSYCHOLOGY: MEMORY FOR PEOPLE 377, 418 (Rod C.L. Lindsay et al. eds., 2007). Research confirms that while confidence may correlate with accurate memory it is by no

to be little concern that information derived from neuroimaging relies on accessing exactly the same unreliable information: human memory.

Much of the legal scholarship on forensic uses of fMRI-based technology stems from the strong call for caution in a 2007 article by Professor Hank Greely at Stanford, which identified many of the issues which continue to be troubling.¹⁶⁹ Greely's argument builds on the current calls for reform of the way in which eyewitness testimony is used in criminal trials. Attorneys involved with the Innocence Project and prominent legal scholars argue that the remarkable number of defendants convicted based on eyewitness testimony, but later acquitted upon analysis of DNA evidence, mandates a reform of photo and in-person line-ups to account for known factors which lead witnesses to misidentify those they have seen committing a crime with full confidence in their own memories.¹⁷⁰

There seems to be a continuing disconnect between neuroimaging technology's claims and the understanding that "[m]emory . . . is adaptive and flexible."¹⁷¹ This hard-won knowledge and deep skepticism seem to vanish in the face of news about scientific studies purporting to convert fMRI scanning data into lie detectors. Whatever information is extracted from neuroimaging will be far closer to dream and fantasy than to reliable facts on which to base either convictions or acquittals.¹⁷²

means a guarantee. Assessing the current state of memory research on the relationship between the witness's confidence and the accuracy of her memory, psychologists Michael R. Leippe and Donna Eisenstadt write that:

Eyewitness confidence is a mixed bag. Properly assessed, it should not be ignored as a potential indicator of identification accuracy. On the other hand, it is overrated by the criminal justice system and by people in general. And, at its worst, it can be what Leippe (1995) referred to as a "miscue" that can cause miscarriages of justice.

Id. at 418.

¹⁶⁹ Henry T. Greely & Judy Illes, *Neuroscience-Based Lie Detection: The Urgent Need for Regulation*, 33 AM. J.L. & MED. 377, 420 (2007) (providing a comprehensive overview of legal regulation of lie detection technology, development of neuroscience based lie detection, and analysis of legal and ethical implications of these technologies being used in courtrooms).

¹⁷⁰ *Eyewitness Misidentification*, *supra* note 19.

¹⁷¹ Paul Kix, *Making Memories*, AM. WAY, Feb. 15, 2011, at 30, 30 (quoting Elizabeth Phelps).

¹⁷² Cf. Owen Bowcott, *CCTV Boom has Failed to Slash Crime, Say Police*, GUARDIAN (May 6, 2008, 7:05 PM), <http://www.theguardian.com/uk/2008/may/06/ukcrime1> (reporting how recent information suggests that the promise of direct access to unfiltered recordings of events in process is not being realized even in CCV).

The testimony of an eyewitness is that person’s recounting of a memory. The promise of admitting evidence obtained from interpretation of fMRI scans is that it will be a more accurate method of distinguishing those telling the truth from those who are lying. Those promoting its usage suggest that this technology will essentially give access to CCV tapes in the brain, which scholars consider a definitive evaluation of eyewitness veracity, thereby definitively evaluating the veracity of a witness’s testimony.¹⁷³ Those looking into the future promise that, in time, these brain images will move beyond their role as lie detectors and actually provide direct access to the images stored there.¹⁷⁴

Over thirty years of research “shows that the human mind is not like a tape recorder; we neither record events exactly as we see them, nor recall them”¹⁷⁵ The writers of these words are not scientists but the founders of the Midwest Innocence Project, a group dedicated to proving the innocence of defendants convicted solely on the basis of eyewitness testimony.¹⁷⁶ Started by Barry Scheck at Cardozo School

¹⁷³ See generally Marc Jonathan Blitz, *Video Surveillance and the Constitution of Public Space: Fitting the Fourth Amendment to a World that Tracks Image and Identity*, 82 TEX. L. REV. 1349 (2004). For further discussion of surveillance in the United States, see *D.C.’s Camera System Should Focus on Emergencies, Not Daily Life*, ELECTRONIC PRIVACY INFO. CTR. (Dec. 2005), <http://epic.org/privacy/surveillance/spotlight/1205/default.html> (expressing concern about increasing installation of CCV cameras in the District of Columbia for the purpose of crime surveillance).

¹⁷⁴ See generally Shinji Nishimoto et al., *Reconstructing Visual Experiences from Brain Activity Evoked by Natural Movies*, 21 CURRENT BIOLOGY 1641, 1643–44 (2011).

¹⁷⁵ *Eyewitness Misidentification*, *supra* note 19; see also Barbara Jean McAtlin, *Eyewitness Identification – Hindrance to Justice?*, JUSTICE: DENIED, <http://www.justice-denied.org/eyewitness.htm> (last visited Feb. 11, 2016).

¹⁷⁶ See *Free the Innocent*, MIDWEST INNOCENCE PROJECT, <http://themip.org/free-the-innocent/> (last visited Feb. 11, 2016). The strongest advocates for publicizing the inherent unreliability of eyewitness testimony are those involved with the Innocence Project. The first paragraphs of the Midwest Innocence Project’s website repeat an argument often made in their books and court briefs:

Eyewitness misidentification is the single greatest cause of wrongful convictions nationwide, playing a role in more than 75% of convictions overturned through DNA testing. While eyewitness testimony can be persuasive evidence before a judge or jury, 30 years of strong social science research has proven that eyewitness identification is often unreliable. Research shows that the human mind is not like a tape recorder; we neither record events exactly as we see them, nor recall them like a tape that has been rewound. Instead, witness memory is like any other evidence at a crime scene; it must be preserved carefully and retrieved methodically, or it can be contaminated.

Eyewitness Misidentification, *supra* note 19.

of Law,¹⁷⁷ the Innocence Project points to the overreliance on eyewitness testimony as the leading cause of wrongful convictions.¹⁷⁸ Criminal defense attorneys have strongly advocated for decreased reliance on eyewitness testimony for a long time.¹⁷⁹ Their cause has gained strength due to the results of a growing national movement to review the cases of those convicted on the basis of identifications made before the widespread use of DNA evidence.¹⁸⁰ The Innocence Project's strongest arguments for limiting the use of eyewitness testimony are the hundreds of cases they have documented where a misidentification places suspicion on an innocent man who becomes entangled and eventually trapped in a case built on what turns out later to be a complete mistake.¹⁸¹

Since it is likely that a technology as expensive as analyzing data from an fMRI scan will be used primarily by prosecutors to convict criminal defendants, the experience of the Innocence Project with the problem of false identification is important. The scientific literature on memory extends beyond vision to include memory of information read or heard.¹⁸² There are many instances in both criminal and civil law when people are asked to recount things they said, things they heard, and things they saw. For example, a police officer who testifies that the dying victim identified the defendant as her killer is recalling the conversation with the victim.

1. Academic Critiques of Eyewitness Testimony

The strongest voice in legal academia for incorporating scientific findings about the limitations of eyewitness testimony into judicial practice is Professor Sandra Guerra Thompson. Professor Thompson has reviewed and analyzed scientific literature on humans' ability to remember what they have seen. While she notes that experiments on

¹⁷⁷ *Our Work*, *supra* note 18.

¹⁷⁸ *Eyewitness Misidentification*, *supra* note 19.

¹⁷⁹ *Id.*

¹⁸⁰ See Duke, *supra* note 166; Parchangelo, "60 Minutes" Shows Unreliability of "Eyewitness" Testimony, RICHARDWANKE.COM (Mar. 13, 2009), <http://richardwanke.com/2009/03/13/60-minutes-shows-unreliability-of-eyewitness-testimony/>.

¹⁸¹ See David Grann, *Trial by Fire: Did Texas Execute an Innocent Man?*, NEW YORKER (Sept. 7, 2009), http://www.newyorker.com/reporting/2009/09/07/090907fa_fact_grann?currentPage=all#ixzz0upr98NTK. The *New Yorker* reported that DNA evidence had exonerated 130 people on death row in the United States, but "Barry Scheck, a co-founder of the Innocence Project, which has used DNA testing to exonerate prisoners, estimates that about eighty per cent [sic] of felonies do not involve biological evidence." *Id.*

¹⁸² See generally, e.g., 1 HANDBOOK OF EYEWITNESS PSYCHOLOGY: MEMORY FOR EVENTS (Michael P. Toglia et al. eds., 2007).

memory are documented over the past one hundred years, the first strong connection between the results of these studies and the actual task of eyewitness identification in a legal setting came in the 1970s with the work of Dr. Elizabeth Loftus.¹⁸³

Professor Thompson advocates for universal application of safeguards to prevent convictions based on false identifications by eyewitnesses, which she labels “system variables.”¹⁸⁴ She writes forcefully that “[t]he fact that so many individuals are wrongly convicted based on eyewitness testimony proves that the criminal justice system as it currently operates fails to live up to the ideals of an adversarial system.”¹⁸⁵ Specifically, she recommends that police departments be required to follow the corroboration requirement from the New York Judicial Council’s 1948 report, whether viewing live suspects or photographs.¹⁸⁶ This requirement set out procedures to minimize practices which contaminate identification.¹⁸⁷

¹⁸³ For an account of Dr. Loftus’s views on the malleability of memory in her own words, see this recording of a lecture entitled “What’s the Matter with Memory” given at the Chautauqua Institution. Chautauqua Inst., *Elizabeth Loftus: What’s the Matter with Memory?*, FORA.TV (July 14, 2009), http://library.fora.tv/2009/07/14/Elizabeth_Loftus_Whats_the_Matter_with_Memory.

¹⁸⁴ Sandra Guerra Thompson, *Beyond a Reasonable Doubt? Reconsidering Uncorroborated Eyewitness Identification Testimony*, 41 U.C. DAVIS L. REV. 1487, 1495–96, 1499 (2008). Professor Thompson divides the problem of making the identification process more reliable into two parts: estimator variables and system variables. *Id.* at 1499. Estimator variables are factors relating to how “the human mind actually perceives events.” *Id.* at 1501. “What happens in front of the eyes is transformed inside the head, and [then] refined, revisited, restored, and embellished in a process as perpetual as life itself.” *Id.* (quoting BARRY SCHECK ET AL., ACTUAL INNOCENCE: WHEN JUSTICE GOES WRONG AND HOW TO MAKE IT RIGHT 55 (2003)). Another way of considering estimator variables is as factors occurring inside the brain.

Professor Thompson contrasts this with system variables, which she defines as “those factors affecting witness accuracy” occurring outside the witness’s brain and “that the legal system can control to some extent.” *Id.* at 1504. Her work and that of other legal scholars seeks to make systemic reform by implementing changes to the methods police use in order to reduce error rates. *See id.* at 1495–96.

¹⁸⁵ *Id.* at 1506.

¹⁸⁶ *Id.* at 1523–24.

¹⁸⁷ *See id.* at 1501 (quoting SCHECK ET AL., *supra* note 184, at 55). Should neuroimaging actually come into courtrooms as evidence of veracity, then it will be very important to have procedures already in place to avoid misinterpretation of the data. However, given how far current neuroimaging is from being ready for even limited introduction, the witness’s recollection and perception problems, or estimator variables, identified as contributing to the high error rate of eyewitness identification are inevitably present, regardless of how well neuroimaging is able to read actual memories. In fact, the better neuroimaging is at accessing actual memories, the more important it will be to understand how the brain’s inherent

2. *The Role of Eyewitness Testimony in U.S. Trials*

Unfortunately, the heuristic of the brain as a camera is a strong one and is not easily dislodged. Professor Thompson has frequently expressed her frustration in the persistence of the legal system's faith in eyewitness testimony, arguing that it is time for the U.S. legal system to recognize "the universally accepted scientific knowledge that eyewitnesses often misidentify strangers."¹⁸⁸ She recently studied a year's worth of appellate cases in which defendants challenged their convictions based on faulty eyewitness testimony, and found that not only did none prevail on that issue, but that "many of the appellate opinions continue to view the eyewitness's degree of certainty as an indicator of reliability."¹⁸⁹ The reliance Americans place on the account of events by people who were there is so deeply ingrained that it is difficult to extract for purposes of examination. Common phrases such as "I saw it with my own eyes" or "show me" are reflections of the primacy of the eyewitness. Moreover, it is not just firsthand sight that is privileged, but also firsthand hearing. The law of evidence is rigid in its insistence on the primacy of words recounted by those who heard them directly.¹⁹⁰ While over time a body of exceptions has developed, the very word "hearsay" in the context of an objection to admitting evidence has become a proxy for "unreliable."¹⁹¹

process of recording and storing memories directly affects the forensic usefulness of the memory retrieved.

¹⁸⁸ *Id.* at 1544. The modern history of studying eyewitness testimony goes back at least hundreds of years. See Gary L. Wells & Lisa E. Hasel, *Eyewitness Identification: Issues in Common Knowledge and Generalization*, in BEYOND COMMON SENSE: PSYCHOLOGICAL SCIENCE IN THE COURTROOM 159, 159 (Eugene Borgida & Susan T. Fiske eds., 2008) ("Long before forensic DNA testing was developed, psychological scientists were publishing articles warning that eyewitness identification evidence appears to be at once both highly persuasive to jurors yet highly subject to error. The interest of psychological scientists in eyewitness memory was clearly evidenced in the early part of the twentieth-century in the writings of Munsterberg (1908). But, it was not until the 1970s that psychological scientists began to launch systematic experiments involving lineups.").

¹⁸⁹ Sandra Guerra Thompson, *Judicial Blindness to Eyewitness Misidentification*, 93 MARQ. L. REV. 639, 642 (2009).

¹⁹⁰ See FED. R. EVID. 801, 802 (defining hearsay and prohibiting its admission). See generally Peter Nicolas, *I'm Dying to Tell You What Happened': The Admissibility of Testimonial Dying Declarations Post-Crawford*, 37 HASTINGS CONST. L.Q. 487 (2010) (tracing history of development of how dying declarations became acceptable exceptions to hearsay).

¹⁹¹ See Ronald J. Allen, Response, *The Evolution of the Hearsay Rule to a Rule of Admission*, 76 MINN. L. REV. 797, 798–800 (1992) (calling for the abolition of the hearsay doctrine because its increasing complexity has outweighed its usefulness). Professor Ronald Allen notes, "The rule imposes other costs as well. Enormous time is spent teaching and writing about the hearsay rule, which are both costly enterprises. In some law schools,

While one might not immediately see eyewitness testimony as a technology, it is an excellent example of how reliance on human memories about what the eyes have seen has been discredited. Most law students have heard of Dr. Loftus's work proving the inaccuracy of eyewitness testimony, and many have experienced classroom exercises in which a startling event is staged and the class afterwards is polled on what they saw. What is so interesting about these experiments is not so much what people do not notice, but what they believe they have seen which they have not. Study after study demonstrates that people are highly susceptible to believing they have seen something when they have not. Dr. Loftus makes her point in a study she described on *60 Minutes*.¹⁹² Under the guise of a marketing survey, she and her team showed Disney World advertisements to people who had visited the theme park.¹⁹³ The advertisements featured a Bugs Bunny character.¹⁹⁴ After surveying them about their reactions to the ad, adult subjects were asked about their own experiences meeting Bugs Bunny at Disney World.¹⁹⁵ As she explains, this could never have happened because Bugs Bunny is not a Disney character and would never have been allowed on the property.¹⁹⁶ Remarkably, having seen the ad and being asked the question, the subjects were happy to provide specific memories in which they themselves had interacted with Bugs Bunny.¹⁹⁷

Given how common it is for people to hold good faith conflicting memories of events at which all were present, it is remarkable how much weight we put on the idea that there is only one truth. While it is common courtroom rhetoric to argue that, when two people remember a conversation differently, someone is lying, research over the past fifty years strongly suggests that both are telling what they consider to be the truth. If the promise of neuroimaging is that it provides direct access to the memory of a person with firsthand knowledge of an event, we need to consider what that means.

students spend over half their time in evidence classes learning the intricacies of the hearsay rule" *Id.* at 800.

¹⁹² CBS News, *Exclusive: The Bunny Effect*, YOUTUBE (Mar. 8, 2009), <https://www.youtube.com/watch?v=eZIPzSeUDDw>.

¹⁹³ *Id.*

¹⁹⁴ *Id.*

¹⁹⁵ *Id.*

¹⁹⁶ *Id.*

¹⁹⁷ *Id.*

It would be unfortunate, but not unusual, for a forensic technique to deliver less than promised. Neuroimaging, however, is particularly dangerous because its promise taps into two human characteristics. The first is confidence in the reliability of our own and others' memories. The second is the longing to uncover what we know is inaccessible to mere mortals: the thoughts of others. Part of this may be because we as individuals trust what we see. Scientists have found that feelings of confidence in identification or memory can be as strong or stronger when the identification is incorrect or the memory is false as when it is true. Indeed, as Professor Thompson points out, the U.S. Supreme Court has never revisited the test it developed in *Mason v. Braithwaite*,¹⁹⁸ which specifically includes "the level of certainty demonstrated by the witness at the confrontation" even though it "has been roundly criticized" for not reconsidering "witness certainty" in light of current scientific beliefs.¹⁹⁹ The Supreme Court has so far not recognized the need for any special screening of eyewitness testimony unless there is evidence of potentially prejudicial state action.²⁰⁰

3. Outlook for the Future

Regardless of whether memories are offered through direct statements or are extracted or evaluated via technology such as analysis of neuroimaging data, the underlying information being relied on is the same and is equally unreliable. The only effective method for preventing undue prejudice from testimony based on memory is for states and the federal government to pass laws which incorporate the findings which have been validated by eighty years of scientific research. Professor Thompson and others have advocated exactly this in promoting the adoption of the model guidelines,²⁰¹ but the starkly pessimistic conclusion of the American Psychological Association (APA)'s amicus curiae brief in *Perry v. New Hampshire*—that

¹⁹⁸ Sandra Guerra Thompson, *Eyewitness Identifications and State Courts as Guardians Against Wrongful Convictions*, 7 OHIO ST. J. CRIM. L. 603, 608–09 (2010) ("Long before the advent of DNA evidence and the release of so many wrongly convicted people, a rich dialogue had existed in the jurisprudence of eyewitness identifications about the risks of misidentification and the role the courts should play in protecting the innocent." (footnote omitted)).

¹⁹⁹ Thompson, *supra* note 189, at 659 (quoting in part *Neil v. Biggers*, 409 U.S. 188, 199–200 (1972)).

²⁰⁰ *Perry v. New Hampshire*, 132 S. Ct. 716, 720–21 (2012) (declining to find error in allowing a jury to evaluate eyewitness testimony directly, without any judicial prescreening, when there was no evidence of "improper law enforcement activity").

²⁰¹ Sandra Guerra Thompson, *What Price Justice? The Importance of Costs to Eyewitness Identification Reform*, 41 TEX. TECH L. REV. 33, 56 (2008).

“[t]raditional [t]ools [o]f [t]he [a]dversary [s]ystem [c]annot [b]e [r]elied [u]pon [t]o [o]vercome [t]he [p]rejudicial [e]ffect [o]f [i]ncorrect [e]yewitness [i]dentifications”²⁰²—calls for measures that set the terms under which it can be presented to the jury at all.

The APA brief reviews the tools which have been suggested to mitigate the prejudice of inaccurate eyewitness testimony in light of the body of scientific evidence about the unreliability rate of eyewitness testimony and the tendency of jurors to find this type of testimony disproportionately convincing and then find each tool unacceptably ineffective.²⁰³ It starts with the premise supported by what it describes as “a seminal 1983 study” where subjects were shown “crime scenarios derived from previous empirical studies and asked . . . to predict the accuracy rate of eyewitness identifications observed in the studies.”²⁰⁴ The researchers found that upon hearing that testimony was based on an eyewitness identification, subjects were significantly more likely to believe the testimony than not.²⁰⁵ The findings have been replicated, including in one study which found that mock juries presented with the same scenarios increased their “conviction rate . . . from 49 percent to 68 percent when a single, vague eyewitness account was added to the circumstantial evidence described in a case summary.”²⁰⁶

Starting from this premise, the APA reviewed cross-examination, cautionary jury instructions, and expert testimony on the inaccuracy of eyewitness testimony, and cited literature finding all of them ineffective in overcoming the initial predisposition to believe eyewitnesses.²⁰⁷ The evidence they cite is quite specific. For example, several studies have directly found that jurors who were given cautionary instructions on the reliability of eyewitness testimony were

²⁰² Brief for Amicus Curiae American Psychological Association in Support of Petitioner at 17, *Perry*, 132 S. Ct. 716 (No. 10-9874).

²⁰³ *Id.* at 17–21.

²⁰⁴ *Id.* at 17 (citing Jonah C. Brigham & Robert K. Bothwell, *The Ability of Prospective Jurors to Estimate the Accuracy of Eyewitness Identifications*, 7 L. & HUM. BEHAV. 19, 22–24 (1983)).

²⁰⁵ *See id.* at 17–18 (describing a study where subjects were shown scenarios describing the conditions under which the eyewitness made the observation and the characteristics of the witness and then made an assessment on how likely it was that this witness was correct).

²⁰⁶ *Id.* at 18 (citing Jennifer N. Sigler & James V. Couch, *Eyewitness Testimony and the Jury Verdict*, 4 N. AM. J. PSYCHOL. 143, 146 (2002)).

²⁰⁷ *Id.* at 18–21.

no more likely to identify factors which might make the testimony less reliable than were jurors who were not so instructed.²⁰⁸

A just and effective law governing the use of information of eyewitnesses, whether obtained directly through testimony or indirectly through either current crude technology or any future method, which actually can accurately retrieve memories of specific events, must then take into account four principles developed through the vast body of scientific literature. First, that eyewitness testimony is inherently unreliable. Second, that there are known factors which make eyewitness testimony unreliable in general. Third, that witnesses are significantly more likely to make an inaccurate identification in a forensic setting when they see only one suspect. And fourth, jurors are already predisposed to “over believe” eyewitness testimony, thus amplifying its prejudicial effects if indeed it is incorrect.

In light of these four factors, and especially in light of the persistence of the negative effect regardless of traditional methods of mitigating prejudicial evidence, juries should not be allowed to hear testimony based on their identification of a witness previously unknown to them unless it occurred in the context of an acceptable multi-subject line-up or picture array. To be effective, such an evidentiary rule would have to be based on facts, not intentions. Thus, the issue in *Perry* as to whether the police orchestrated the witnesses seeing the defendant standing with police at the crime scene would be irrelevant. Just as a search or seizure or confession can become irrevocably tainted the instant an illegal event occurs, so would the testimony of a witness who has not identified the defendant in a scientifically based fair context. Such a rule would avoid the need to make distinctions among the ways in which an unfair identification took place. It would not only prohibit prosecuting attorneys from orchestrating in-court identifications but would also hold them responsible should such an event occur spontaneously either through one of their witnesses or from any person present in the courtroom. The effect of a comprehensive rule would be to create an automatic mistrial whenever a jury hears an eyewitness identify a defendant, previously unknown to the jury without first having done so in a fair process supported by contemporary science.

Although the solution proposed above is unlikely to be easily or quickly converted into law, the first step is a recognition that the debate

²⁰⁸ *Id.* at 20 (citing Brian L. Cutler et al., *Nonadversarial Methods for Improving Juror Sensitivity to Eyewitness Evidence*, 20 J. APPLIED SOC. PSYCHOL. 1197, 1198–1200, 1202–06 (1990)).

over the use of neuroimaging as a method of accessing or characterizing human thought is not one over technology. The debate is over introduction of memory-based information in a court of law given the demonstrated human tendency to overestimate both forensic technologies and eyewitness testimony.

H. Conclusions Based on Data from fMRI Scans Share All the Flaws of Polygraphy

Despite its early criticism, the polygraph is still very much in use and its results continue to be offered as evidence.²⁰⁹ The growing acceptance of polygraphy evidence for proof of veracity in state and even federal courts makes it even more important to understand the limits it shares with functional magnetic imaging.

In its current stage, the claims made for neuroimaging as a truth verifier are similar to those once made for the polygraph in that it purports to provide a real-time assessment of statements by an individual human. This is in contrast to other techniques, like phrenology, which speak more to general character.²¹⁰

²⁰⁹ See *Polygraph Litigation*, ANTIPOLYGRAPH.ORG, <https://antipolygraph.org/litigation.shtml> (last visited Feb. 11, 2016). Much of the current literature critical of polygraph evidence is collected in the website of a private group called “Antipolygraph.org” which “seeks the complete abolishment of polygraph ‘testing’ from the American workplace.” *Comprehensive Employee Polygraph Act*, ANTIPOLYGRAPH.ORG, <http://antipolygraph.org/ceppa.shtml> (last visited Feb. 11, 2016). The group writes, “Now that the National Academy of Sciences has conducted an exhaustive study and found polygraph screening to be invalid, and even dangerous to national security, Congress should extend the protections of the 1988 Employee Polygraph Protection Act to all Americans.” *Id.* (emphasis omitted).

²¹⁰ See *United States v. Gipson*, 24 M.J. 246, 249 (1987) (“At the bottom [of the scientific evidence hierarchy] lies a junk pile of contraptions, practices, techniques, etc., that have been so universally discredited that a trial judge may safely decline even to consider them, as a matter of law. To that level have been relegated such enterprises as phrenology, astrology, and voodoo. In the middle is that range of scientific and technical endeavor that can neither be accepted nor rejected out of hand. To this group, based on the information available to us, we assign the polygraph.”); 4 WEINSTEIN’S FEDERAL EVIDENCE § 702.05[2][b] (Joseph M. McLaughlin et al. eds., 2d ed. 1997) (“The reliability requirement is designed to exclude so-called ‘junk science’—conjuring up memories of the phrenology craze where the bumps on a person’s head were felt in order to determine character traits—from federal courts. At the very least, scientific opinions offered under Rule 702 must be based on sound scientific methods and valid procedures.”), *quoted in* *Logerquist v. McVey*, 1 P.3d 113, 124 (2000); Stacey A. Tovino, *Imaging Body Structure and Mapping Brain Function: A Historical Approach*, 33 AM. J.L. & MED. 193, 195–208 (2007) (discussing the history of the development of the science of phrenology and its adoption and then rejection by the American legal system).

The Supreme Court's rejection of the attempt to introduce polygraph information as evidence was so vehement that the resulting opinion, *Frye v. United States*, created the standard by which all scientific evidence was evaluated for use in the courtroom for the next seventy years until *Daubert*. The Court's primary objection to introduction of the polygraph report was not based on its own assessment of polygraphy's usefulness, but rather that the polygraph's scientific reliability was not generally accepted by the scientific community.²¹¹

It is useful to remember that polygraph evidence is not always offered as direct proof of the elements of the crime. In *Mallory v. United States*, the Court rejected a confession that was produced after the police arrested a number of individuals in the area where a rape had occurred, held them in the police station for over four hours, and then administered a polygraph.²¹²

Another way of assessing the limits of neuroimaging technology is to see how similar its limits are to those of polygraph and concomitantly how it has some even greater limitations than polygraphs. First, both technologies measure people's own feelings about the information they are giving. If the person being questioned does not believe he or she is being deceptive, then the machine is unlikely to register deception. This is especially true when the question is targeted at a memory. For example, a question like "did you hurt the child?" asks for the examinee's memory of the contact. Here, the issue will be the examinee's belief based on his memory of the event.

Because it is physically impossible to have a subject simultaneously undergoing neuroscanning and be effectively wired to a polygraph, any claim that neuroimaging is more accurate than polygraph must be based on comparisons of the results of different studies done at different times. Professionals who work in the field of polygraphy complain bitterly that this is completely unfair since the technology of both administering and analyzing polygraph data is constantly evolving and the results of past studies are not reflective of the accuracy of results available today.²¹³

²¹¹ See *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923); Andre A. Moenssens, *Polygraph Test Results Meet Standards for Admissibility as Evidence*, in *LEGAL ADMISSIBILITY OF THE POLYGRAPH* 14 (Norman Ansley ed., 1975).

²¹² *Mallory v. United States*, 354 U.S. 449, 450–51 (1957).

²¹³ For a survey of the development and historical use of polygraph technology, see generally Don Grubin & Lars Madsen, *Lie Detection and the Polygraph: A Historical Review*, 16 J. FORENSIC PSYCHIATRY & PSYCHOL. 357 (2005).

The same ability to analyze data and report, for example, the frequency with which a particular feature is present, is used in analyzing neuroimaging data and polygraph data. What computers do when analyzing data is no more difficult than what a scientist could do for herself. The difference is the speed at which computers can do it. Science has been revolutionized by the development of computers that perform rapid calculations on large volumes of data. For example, it is one thing for even a highly trained examiner to study sets of fingerprint impressions, notice distinctive features, and compare them to other samples. But it is quite another for a computer to do the same thing with thousands or millions of samples.

An important factor in the accuracy of the analysis is the amount of information available to analyze. Unlike polygraphs, as noted repeatedly by scientists urging caution in ascribing conclusions to neuroimaging data, the samples are very, very small.²¹⁴ This is because neuroimaging equipment is large and expensive.²¹⁵

Another difference is the ability to attract subjects and the characterizations of the subjects who are willing to participate. While neither neuroimaging nor polygraphy is physically painful, the former is far more uncomfortable than the latter.²¹⁶ In fact, one of the drawbacks of all magnetic resonance imaging is the number of people who cannot physically tolerate the claustrophobia of lying still in a very tight metal tube for forty-five minutes. While a polygraph researcher can bring his equipment to a prison or even a retirement home and in a few days acquire many data sets to analyze, this is impossible given the physical characteristics of fMRI equipment. However, polygraphy's appeal is so strong that, despite being banned from use in federal court because it is likely to “mislead” the jury, faith in it remains, and it is still in wide use for investigations and interrogations.²¹⁷

²¹⁴ See, e.g., Tal Yarkoni, *Sixteen is Not Magic: Comment on Friston (2012)*, [CITATION NEEDED] (Apr. 25, 2012), <http://www.talyarkoni.org/blog/2012/04/25/sixteen-is-not-magic-comment-on-friston-2012> (responding to a previous article claiming that a sample size of sixteen to thirty-two is ideal for fMRI studies). Author's note: [Citation Needed] is a blog commenting on the use of statistical data to prove or disprove statements made by members of the scientific and other communities.

²¹⁵ See *How Much Does an fMRI Machine Cost?*, QUORA, <https://www.quora.com/How-much-does-an-fMRI-machine-cost> (last visited Feb. 11, 2016).

²¹⁶ See *Magnetic Resonance, Functional (fMRI) – Brain*, RADIOLOGYINFO.ORG (June 23, 2014), <http://www.radiologyinfo.org/en/info.cfm?pg=fmribrain>.

²¹⁷ See generally KEN ALDER, *THE LIE DETECTORS: THE HISTORY OF AN AMERICAN OBSESSION* (2007) (recounting the history of the United States' adoption of the polygraph

The Supreme Court expressed its skepticism of the value of polygraph evidence in a 1998 case, *United States v. Scheffer*, challenging the military's policy of refusing to admit evidence of polygraph tests in court martials.²¹⁸ Military Rule of Evidence 707 prohibits the introduction of polygraph evidence into a court martial by either the prosecution or the defense.²¹⁹

machine to solve crimes and evaluate the truthfulness of witnesses at trial); Jeffrey Bellin, *The Significance (If Any) for the Federal Criminal Justice System of Advances in Lie Detector Technology*, 80 TEMP. L. REV. 711 (2007) (examining three common evidentiary objections to lie detector evidence and to the underlying validity of the science of lie detectors: "(1) lie detector evidence impermissibly invades the traditional province of the jury to evaluate witness credibility, (2) it is barred under Federal Rule of Evidence 403 because it is likely to 'mislead' the jury, and (3) it violates Federal Rule of Evidence 704's prohibition of expert testimony regarding the 'ultimate issue'").

In line with the theme of emerging technologies being adopted for forensic use, the development of Röntgen Rays and then the X-ray, which literally provided an image of the inside of a person's head, was also quickly adapted for courtroom use and almost as quickly rejected as incapable of providing information useful to a court proceeding. Tovino, *supra* note 210, at 207–17 ("Although x-ray is capable of showing the detailed structure of the skull, it cannot distinguish among the brain's soft tissues. X-ray also does not reveal how the brain functions, a limitation of which nineteenth-century courts were aware." (footnotes omitted) (citing WILLIAM R. UTTAL, *THE NEW PHRENOLOGY: THE LIMITS OF LOCALIZING COGNITIVE PROCESSES IN THE BRAIN* 61 (2001))).

²¹⁸ See *United States v. Scheffer*, 523 U.S. 303, 312 (1998).

²¹⁹ MIL. R. EVID. 707; *Scheffer*, 523 U.S. at 305. In this case, the defendant, Airman Scheffer, facing court martial for drug use, sought to introduce the results of a polygraph exam, which proved his claim that he had not knowingly used drugs since entering the Air Force was truthful. *Id.* at 306. Unfortunately for Airman Scheffer, a urinalysis came back indicating the presence of methamphetamines. *Id.* He appealed his conviction on the grounds that Rule 707 was unconstitutional and that he should have been able to introduce the polygraph findings as evidence of his innocence to counter the urinalysis. See *id.* at 307–08. The Supreme Court upheld the Rule and the Air Force's decision to bar the polygraph evidence, holding that the Air Force's only constitutional obligation was to admit reliable evidence, which, based on the Court's review of the literature, did not include the results of a polygraph. *Id.* at 309.

The Court also took the opportunity to express its view about polygraph's inherent unreliability. Justice Thomas wrote,

It is equally clear that Rule 707 serves a second legitimate governmental interest: Preserving the court members' core function of making credibility determinations in criminal trials. A fundamental premise of our criminal trial system is that "the jury is the lie detector." Determining the weight and credibility of witness testimony, therefore, has long been held to be the "part of every case [that] belongs to the jury, who are presumed to be fitted for it by their natural intelligence and their practical knowledge of men and the ways of men."

Id. at 312–13 (alteration in original) (citation omitted) (first quoting *United States v. Barnard*, 490 F.2d 907, 912 (C.A.9 1973); then quoting *Aetna Life Ins. Co. v. Ward*, 140 U.S. 76, 88 (1891)). Further commenting on the history of polygraph evidence, Justice Thomas wrote,

Governmental use of polygraph tests, however, is primarily in the field of personnel screening, and to a lesser extent as a tool in criminal and intelligence

While it is too early to say that all neuroimaging evidence which purports to evaluate the truthfulness of a witness’s testimony is inherently unreliable; before it can be admitted, it should at least surpass a technology which has been found inherently unreliable.

I. Neuroimaging Shares the Inherent Weaknesses of Other Forensic Scientific Technologies

Proponents of introducing evidence retrieved from the brain of a witness are essentially asking that this technology be added to the list of forensic sciences now used in U.S. courts, and, by doing so, subject it to the same reappraisal being given to even long-accepted technologies, such as fingerprint and DNA identification.

Like fingerprint analysis, neuroimaging depends on patterns which are unique to each individual. A consistent thread that runs through all forensic technologies claiming to identify humans, either through physical characteristics or behavioral traits, is that they consistently underestimate the diversity of the human race.²²⁰ Just as DNA matching is facing criticism for failure to maintain a sufficiently large database of the genetic make-up of the U.S. population, a frequent criticism of the results of lie-detecting experiments using neuroimaging is that they are based on very few people.²²¹

investigations, but not as evidence at trials. Such limited, out of court uses of polygraph techniques obviously differ in character from, and carry less severe consequences than, the use of polygraphs as evidence in a criminal trial. They do not establish the reliability of polygraphs as trial evidence, and they do not invalidate reliability as a valid concern supporting Rule 707’s categorical ban.

Id. at 312 n.8 (citation omitted).

Polygraph exams still have many supporters and are still widely administered. *See, e.g.*, Daniel J. Mangan et al., *Rebuttal to Objections by Iacono and Verschuere et al.*, 95 PHYSIOLOGY & BEHAV. 29, 31 (2008) (claiming that the Quadri-Track Zone Comparison Technique can if properly administered result in up to .99 accuracy in detecting deception and that the test has “met the National Research Council’s scientific criteria” for reliability).

²²⁰ *See* Brent Garland & Mark S. Frankel, *Considering Convergence: A Policy Dialogue About Behavioral Genetics, Neuroscience, and Law*, 69 LAW & CONTEMP. PROBS. 101, 102 (2006) (considering whether attempts will be made to identify individuals as having criminal or violent tendencies based on their thought patterns).

²²¹ *See* Francis X. Shen, *Neuroscience, Mental Privacy, and the Law*, 36 HARV. J.L. & PUB. POL’Y 653, 656 (2013) (explaining that “[t]he chief challenge emerging from advances in brain science is not the insidious collection of brain data, but how brain data is (mis)used and (mis)interpreted in legal and policy settings by the government and private actors alike”); *cf.* Andrew Pollack, *DNA Evidence Can Be Fabricated, Scientists Show*, N.Y. TIMES (Aug. 17, 2009), <http://www.nytimes.com/2009/08/18/science/18dna.html> (reporting that Israeli scientists have demonstrated that it is possible to fabricate DNA evidence including

III

WHY THE PREJUDICE OF NEUROIMAGING OUTWEIGHS ITS LOW
PROBATIVE VALUE

The problem with using neuroimaging technology in the courtroom as a method of assessing witness credibility is that it perpetuates continued misunderstanding of what exactly is being retrieved and therefore is not of assistance to the jury.²²² Presenting a technology as a “lie detector” suggests that it surpasses the human ability to detect deception and is inconsistent with the purpose of scientific evidence in a criminal trial.²²³

A. fMRI Results Cannot Replace the Jury in Civil or Criminal Trials

Scientists discussing the technology’s limitations do not always use language that lawyers and other lay people understand. The current limits of neurotechnology are well understood within the scientific community, however.²²⁴

A better understanding of what current researchers are claiming as success in detecting deception reveals how limited a forensic tool neuroimaging really is. The studies shown so far claim to identify brain

“construct[ing] a sample of DNA to match that profile without obtaining any tissue from that person”).

²²² To the extent that this technology is offered as a way of retrieving memories from willing but forgetful witnesses it faces the same objections as other efforts to improve recall such as hypnosis or medication or even direct electrical stimulation. *Cf.* Lorinda B. Camparo et al., *Interviewing Children About Real and Fictitious Events: Revisiting the Narrative Elaboration Procedure*, 25 LAW & HUM. BEHAV. 63 (2001) (describing and evaluating a technique in which children are showed cards as prompts for them to recall more about an event in the past without the risk of contaminating the memories with suggestions); Namita Nayyar, *Improving Memory and Concentration with Yoga*, WOMEN FITNESS (Sept. 30, 2014), http://www.womenfitness.net/yoga_ad.htm (suggesting yoga as a memory enhancer).

²²³ See Merlino et al., *supra* note 123, at 417–18.

²²⁴ Kozel et al., *supra* note 89, at 10. Describing a very successful study in which they were able to replicate earlier results in detecting deception among twenty-nine research subjects, the scientists cautioned,

Although this is an important validation step, further work needs to address how robust these findings might be with different testing scenarios and populations. The scenario used was a simple laboratory paradigm with healthy adult participants. Testing when there is greater risk (e.g. prison, large financial loss, etc.) or in people with illnesses taking medications may result in a different outcome. Another important consideration is that this study only provides support for the analysis methodology used in these studies. Different analysis strategies and testing formats will require independent evaluation and replication.

Id.

patterns, which consistently accompany deliberate attempts by subjects to provide false information. For example, a subject holding an ace of clubs reports he is holding a queen of spades. A separate but related line of research involves monitoring the brain patterns of subjects who are shown pictures of people or places with which they are or are not familiar.²²⁵ Whatever the success rates of these studies, they all share common limitations: they have been done on only a small sample of people and those people have all been willing subjects.²²⁶

1. *The Role of the Jury*

It is common knowledge that, in the United States, the jury's function is to hear the evidence presented by both sides and make a determination of the relevant facts. Often this requires the jury to choose between, or among, inconsistent testimony by witnesses. In choosing one witness's account of events over another's, they become human lie detectors. Both civil litigants and those facing serious criminal charges are entitled to a trial by jury. The jury is then instructed by the judge on the legal standards for the matter before it and the jury applies the law to the facts it has found. While juries in the United States are the ultimate deciders of the facts, it is the judge's job to evaluate what evidence they will have to make their decision.²²⁷ The

²²⁵ MEDINA, *supra* note 32, at 61 (identifying that these studies can show with strong reliability specific neurons which react to specific images or words).

²²⁶ See Justin R. Masterman, *Reading the Mindreading Studies: Current Debates About fMRI Research Methods Bear on Policy Questions*, SCI. PROGRESS (Apr. 23, 2009), <http://www.scienceprogress.org/2009/04/fmri-mindreading-studies/>. For an explanation of the Vul study Masterman discussed set to music, see The TAWOP Channel, *A Public Debate on Statistics in fMRI Research*, YOUTUBE (Dec. 31, 2009), <http://www.youtube.com/watch?v=nMZvpVwfObE> (explaining the limitations of FMRI as a method of reading thoughts, neuroscientist Ed Vul explained that scientists are only at the beginning of the process of associating meaning to the brain activity they measure).

²²⁷ See George Fisher, *The Jury's Rise as Lie Detector*, 107 YALE L.J. 575, 577–78 (1997) (noting the relatively recent role of the Anglo-American jury as evaluators of credibility in criminal trials). Fisher notes that it is only within the last 150 years of “the nearly 800-year history of the criminal trial jury” that juries were asked to “choose between the sworn testimony of accuser and accused at a criminal trial” because “[n]ot until the second half of the nineteenth century could accused criminals anywhere in the common law world testify under oath at their own trials.” *Id.* at 579. Fisher's thesis is that the rise of the jury to its current status has little to do with any real belief that “the jury can answer all credibility questions” and more with a desire to “present to the public an ‘answer’—a single verdict of guilty or not guilty—that resolves all questions of credibility in a way that is largely immune from challenge or review. By making the jury its lie detector, the system protects its own legitimacy.” *Id.* Although Fisher's article is structured to explain and

judge does so according to the rules of evidence adopted by her state, or, if the case is in federal court, by the Federal Rules of Evidence. The judge's role as gatekeeper is especially important when either party wants the jury to consider scientific evidence, such as the results of an fMRI test.

2. *How Good Do Juries Need to Be at Detecting Lies?*

Research suggests that none of us, jurors included, are as good at detecting when we are being deceived as we think we are. In part, this is because people have developed beliefs about the behavior of liars that are actually better proxies for nervousness than deliberate deception.²²⁸

Whether juries should be given the authority to assess witness credibility is beyond the scope of this Article, except to say that it is unlikely to be taken away from them in the near future.²²⁹ It has become something of a legal academic truism that jurors are not especially successful at distinguishing between truth tellers and liars.²³⁰ It is also generally accepted that the collective wisdom of jurors is no better than the limited skills of ordinary individuals in detecting lies.²³¹ Others, such as Professor Max Minzner, believe that the concerns about jurors' abilities may well be overstated based on a misunderstanding of the behavioral research presented to the legal community. He writes that the research on the poor accuracy of assessing demeanor as a marker of truth telling has been overgeneralized:

support this thesis, it also serves as an excellent resource for understanding the jury's role. "[E]vidence from the jurors, this they hide entirely from us." *Id.* at 578.

²²⁸ See Pardo, *supra* note 76, at 302 & n.2.

²²⁹ Neuroimaging technology's ability to aid lie detection is complicated by a recent significant misunderstanding in the academic community regarding juries' ability to serve as fact finders, with many critics attributing the ability of jurors to tell truth telling from lying lies as no better than chance. See Max Minzner, *Detecting Lies Using Demeanor, Bias, and Context*, 29 CARDOZO L. REV. 2557, 2564–65 (2008) (discussing the problems with allowing juries to serve as principal deception detectors).

²³⁰ *Id.*

²³¹ *Id.* at 2565. There may be a difference between the perception that jurors are not skilled at distinguishing witnesses telling the truth from those who lie and the reality. Professor Max Minzner suggests that the "dismal view among legal academics" of jurors' abilities is based on social science research which does not duplicate conditions in the courtroom. *Id.* at 2566. Minzner points out that while evaluations of a witnesses' demeanor may not be very useful in assessing credibility, jurors actually make decisions within a specific context which provides much more information than just demeanor. See *id.* at 2567.

While the newest results on lie detection support the now-traditional view in legal academia that demeanor is not a valuable tool in making credibility decisions, they undermine the further conclusion that accurately detecting lies is impossible and, as a result, we should view credibility decisions by juries as no better than a coin flip.²³²

Instead, he writes: “We just do not yet know enough about bias, base rates, and the value of context to say whether the social science evidence supports the currently skeptical view on legal lie detection.”²³³ When looked at as a whole, we see that people are, in fact, fairly skilled at telling when a person they know well is lying about something important.

*B. fMRI Presents Prejudice Versus Probative Concerns in
Investigations as Well as Trials*

The legal constraints on the government’s use of brain imaging techniques extend beyond those which apply to introducing evidence in a U.S. courtroom. Much of the research into reading thoughts has been funded by the federal government, either directly or channeled through seemingly independent private foundations.²³⁴ The federal government has expressed interest in using brain imaging technology as an interrogation tool and also as a method of identification.²³⁵ Research suggests that brain patterns are highly individualized, and perhaps absolutely unique, so that a brain scan of an individual can be used to identify that individual.²³⁶ Of course, like fingerprints, this depends on the subject having been available earlier for a baseline brain scan—at which point both DNA samples and fingerprints could also have been obtained.

Lives and reputations can be ruined by false accusations, such as Gary Condit from the Chandra Levy scandal,²³⁷ as well as by time

²³² *Id.* at 2578.

²³³ *Id.*

²³⁴ See MORENO, *supra* note 30, at 102–03 (discussing brain imaging projects funded by DARPA).

²³⁵ See *id.* at 101 (reporting that DARPA has funded a variety of brain imaging projects such as a device to “measur[e] brain activity and wirelessly transmit all that information to a computer that will interpret the information for various purposes”).

²³⁶ K.V.R. Ravi & Ramaswamy Palaniappan, Recognising Individuals Using Their Brain Patterns (2005) (conference paper), <http://www.computer.org/csdl/proceedings/icita/2005/2316/02/231620520.pdf>.

²³⁷ See Associated Press, *Ingmar Guandique, Chandra Levy Murder Suspect, Due in D.C. Court*, HUFFINGTON POST (May 25, 2011, 4:30 PM), <http://www.huffingtonpost.com>

wasted by false leads. This is especially true when a false lead diverts the investigation from other suspects.

Usually, the hope of those investigating a crime is that the evidence they use to identify suspects and even arrest them are available for use in court; this is not always the case. An immediate need for information may supersede the need for admissible evidence.

Investigators and police should be, but mostly are not, limited to using methods not admissible in court when nothing else has worked and the information is of vital importance. Within this context, neuroimaging may seem like an attractive option because, to the best of anyone's knowledge, it is not harmful to the subject being scanned.²³⁸

There is nothing unusual or even inappropriate about using inadmissible evidence in an investigation, but the harm comes when investigators and the public overestimate the accuracy of the technology involved. This is always the case with technology, but it is more serious in neuroimaging because of the aura of superhuman ability to look into people's minds. For example, while a desperate family may well employ a psychic, it is unlikely that if a psychic identified someone as the killer he or she would face a seriously increased risk of suspicion or indictment.²³⁹

There are also legal consequences to identifying someone as a person of interest or having knowledge based on information that the

/2010/05/14/ingmar-guandique-chandra_n_576148.html; Associated Press, *Suspect Indicted in Murder of Chandra Levy*, FOX NEWS (May 21, 2009), <http://www.foxnews.com/story/0,2933,520916,00.html>; *Who Killed Chandra Levy?*, WASH. POST: SPECIAL SERIES (July 11, 2008), <http://www.washingtonpost.com/wp-srv/metro/specials/chandra/>.

²³⁸ See Jennifer J. Kulynych, *The Regulation of MR Neuroimaging Research: Disentangling the Gordian Knot*, 33 AM. J.L. & MED. 295, 295–96 (2007). One of the advantages of fMRI technology is that it does not involve exposure to harmful radiation, however that does not mean it is an entirely risk free procedure. *Id.* However, although “usually” “benign” “an MRI scanner is a powerful medical device, capable of causing serious injury or death if operated carelessly.” *Id.*; see also Steven Goldberg, *MRIs and the Perception of Risk*, 33 AM. J.L. & MED. 229, 232–33 (2007) (noting that although the name of the technology was changed from “nuclear magnetic resonance” imaging to “magnetic resonance” imaging in order to reduce the perception of risk in fact “MRIS, unlike x-rays, do not expose patients to radioactivity.” (footnote omitted)).

²³⁹ See Michael B. Dorff, *Confident Uncertainty, Excessive Compensation & the Obama Plan*, 85 IND. L.J. 491, 499 (2010). The immediate problem faced by those trying to use the testimony of a psychic to prove guilt would be admissibility. There is no legal acknowledgement of the ability of any person to have superhuman ability to predict the future: “Foretelling events is generally relegated to the realm of fantasy or science fiction. Although there are thousands of mediums and spiritualists that claim prophetic powers, and even respected public figures are sometimes rumored to consult psychics, few people will publicly admit to taking precognitive abilities seriously.” *Id.* (footnotes omitted).

police themselves know to be unreliable. While law enforcement personnel have a qualified immunity for good faith acts that they take in furtherance of their job, there are limits. For example, a police department which publicly announced that someone was a person of interest—based on nothing but the belief of a fortune teller—might well find itself facing a section 1983 action for violating the person’s constitutional rights.²⁴⁰ This remedy may provide a safeguard against false accusations based on fMRI scans.

IV

THE DANGERS OF IRREPARABLE HARM: WHY IS IT NECESSARY TO BAN TRUTH VERIFICATION TECHNOLOGY RATHER THAN MODIFY IT?

A. In the Courtroom

Far worse than the inability to escape the stigma of a wrongful accusation is to be arrested, tried, convicted, or executed based on this accusation. As in investigations, once information based on neuroimaging is presented to the jury, it will inevitably affect their decision. Although every state’s evidence laws characterize expert testimony as an aid to jury deliberation—which the jury can choose to take into consideration or not—the reality is quite different. As stated previously in Part II.D.3, much has been written about the CSI effect with both defense attorneys and prosecutors claiming harm.²⁴¹ Nevertheless, it would be difficult for any prosecutor to deny that her hope in introducing forensic evidence is for the jury to believe that the defendant’s guilt, or at least presence at the scene of the crime, is a

²⁴⁰ See 42 U.S.C. § 1983 (2012) (“Every person who, under color of any statute, ordinance, regulation, custom, or usage, of any State or Territory or the District of Columbia, subjects, or causes to be subjected, any citizen of the United States or other person within the jurisdiction thereof to the deprivation of any rights, privileges, or immunities secured by the Constitution and laws, shall be liable to the party injured in an action at law, suit in equity, or other proper proceeding for redress, except that in any action brought against a judicial officer for an act or omission taken in such officer’s judicial capacity, injunctive relief shall not be granted unless a declaratory decree was violated or declaratory relief was unavailable. For the purposes of this section, any Act of Congress applicable exclusively to the District of Columbia shall be considered to be a statute of the District of Columbia.”).

²⁴¹ See Cole & Dioso-Villa, *supra* note 130, at 1342–43. “The term CSI effect appears to have entered the popular lexicon late in 2002 in an article in *Time* magazine” cited by Cole and Dioso-Villa. *Id.* at 1338. That article described “a growing public expectation that police labs can do everything TV labs can.” Jeffrey Kluger, *How Science Solves Crimes*, *TIME* (Oct. 21, 2002), <http://content.time.com/time/magazine/article/0,9171,1003480,00.html>.

scientific fact. In light of the contemporary battle over the unquestioning adoption of almost any forensic technique as dispositive, it is likely that there will be curbs to the indiscriminate presentation of forensic evidence.

Technology which purports to read minds, however, has a different effect than that intended to match bullets. Jurors who are presented with technology that claims superhuman powers are in reality being told to substitute its findings for their judgment. Moreover, the danger of allowing unreliable evidence goes deeper than jury intimidation. Once evidence is introduced, it can be cited by the losing party as part of a motion to set aside the verdict on the grounds that the jury did not properly credit the available evidence. Applying the standard of what "a reasonable jury" would find, a trial judge is free to set aside a verdict. By the time forensic evidence is admitted, no effort at mitigation can effectively eliminate its influence over the judge and the jury.

One of the most serious problems with letting the jury hear evidence obtained through fMRI is the claim that it works without the subject's cooperation. While it may be true that, unlike the polygraph, the brain's reaction to a familiar object is outside the scope of human control, there remains no definitive evidence and much questioning of this oft-repeated claim. An even more basic problem stems from the definition of cooperation. So far, neuroimaging requires that the subject sit still during the examination. Nevertheless, even the possibility that someone's Fourth Amendment right against unreasonable search and seizure or Fifth Amendment right against self-incrimination is being put in jeopardy requires much further consideration of proper treatment at trial before juries should be able to hear that evidence.

Science has yet to unravel the mystery of thought. Once we set aside the construct of memories existing in the brain like images on a hard drive or a videotape, we are left with a strong possibility that even if it were somehow possible to download information directly from the brain, the content would be no different than what a cooperative witness could tell us. Unless we posit a deeply buried recording system to which a person recounting a memory has no access, everything known about the flaws of memory for oral statements and witnessed events applies just as much to information extracted via neuroimaging. Assuming no intent to deceive, the oral testimony a person makes about his recollection of an event is simply a reflection of whatever "memory" would be captured by an fMRI. Even worse for forensic purposes, the brain does not flag memories as having been distorted. Rather, whatever phenomenon makes a person believe that he is

recounting what he saw is the same whether the recounting is accurate or not. It is as if modern neuroscience has proved the often stated aphorism that people can make their own reality.

*B. How the Characteristics of Information Acquired Through
Neurotechnology Are Unhelpful to Investigators and Prejudicial to
Litigants*

This Article considers the functional limits of current neurotechnology by considering the underlying flawed premise that brain activity detected while a person is giving a deceptive answer actually reflects deception in high stress situations. However, another criticism can be made of even the most accurate "lie detector"; alone, it is of very limited utility in the real world of criminal investigations or jury trials. If the best neuroimaging can do is identify the sincerity of "yes" or "no" answers, it is a very expensive machine for playing Twenty Questions.²⁴² It is also not significantly more helpful to investigators than the much more cost-effective existing polygraph technology.

Consider this scenario familiar to viewers of cable news shows like *Nancy Grace*: a child or young woman is missing and the last person to see the missing person denies any knowledge of what happened.²⁴³ The police declare this witness a "person of interest" but cannot force him or her to testify. A technology that materially determines whether or not the witness is being truthful in his or her denials of knowledge is somewhat like a high-tech version of Twenty Questions. The game is certainly impossible if the informant is lying about the item's characteristics, and it becomes an inefficient and often frustrating method of discovering anything but the simplest factual information.

²⁴² Twenty Questions is a game; the goal is to identify an object another is thinking of only using yes or no questions. *Twenty Questions*, GROUP-GAMES.COM, <http://www.group-games.com/stationary-games/twenty-questions.html> (last visited Feb. 11, 2016). For more on the rules of Twenty Questions, see *id.*

²⁴³ See, e.g., *Is Misty Croslin Telling All?*, CNN (Jan. 29, 2010, 10:46 AM), <http://nancygrace.blogs.cnn.com/2010/01/29/is-misty-croslin-telling-all/>. Misty Croslin was home with her step-daughter Haleigh Cummings when she claimed that "men" came in and took her. See *id.* Husband Ron Cummings claimed Misty knew more about it. See *id.* Misty never revealed any further information about her daughter, but was later imprisoned for drug charges. Arelis R. Hernández, *Misty Croslin: Woman at Center of Missing-Girl Case Sentenced to 25 Years in Drug Case*, ORLANDO SENTINEL (Jan. 11, 2011), http://articles.orlandosentinel.com/2011-01-11/news/os-misty-croslin-sentenced-drugs-20110111_1_hank-croslin-haleigh-cummings-ronald-cummings.

Similarly, even if an fMRI could provide an advantage over the game by indicating that the respondent is lying in his answers, would finding out that the witness is not being truthful in denying knowledge really bring the police any closer to locating the victim? Suppose even that the person of interest is the mother of the missing child. At best, the findings would reveal deliberate deception in answers to a series of specific questions, such as “did you kill your child?” Nevertheless, whether she is being truthful in stating that she did not kill her child brings us no closer to finding that child.

As unhelpful as this kind of interrogation is to finding a missing child, it is even less helpful in convicting the mother of a crime. Like the results of a polygraph, what we really know is that she believes she did not kill the child. We cannot, through yes or no questions, get the specifics of what she did or when, let alone her state of mind. The law may find that she engaged in conduct that would make her legally liable, even while she retains the strong conviction of having done nothing wrong—perhaps because she blames others for whatever harm the child suffered.

C. The Limits of Neuroimaging-Based Technology as a Method of Truth Detection

So many people have a financial stake in the continued funding of fMRI research, let alone using the results, that its limits are well hidden in its publicity. The intent is not, at least for most researchers, deliberate deception so much as genuine excitement about real discovery. The problem is that an exciting discovery to a cognitive scientist is very different from a fully developed technology ready for the courtroom. With companies already marketing the technology, however, there is real danger of failure to understand the significant distance between the laboratory and the courtroom.

The very limits of today’s neurotechnology as a method of deception detection, let alone mind reading, are highlighting what researchers trumpet as their greatest discoveries. As discussed previously, even if it were possible to obtain direct access to human memory with perfect accuracy, this would not be a significant improvement over current methods of investigation or trial. The current probative value and high prejudicial nature of interpreted information obtained through neuroimaging is so limited that it cannot meet even the threshold requirements for contemporary forensic science or investigative techniques.

The problem goes far deeper than a concern over intermediate technology. The limits of neuroimaging in its current Twenty Questions form are only part of the reason for distrusting its findings. No matter how well this technology succeeds in retrieving memories, those memories will share all the flaws and limitations identified in the study of eyewitness testimony. One of the more lovely images of retrieving a memory comes from the *Harry Potter* series in which a device called a “pensieve” is used to make memories take on the physical form of a wisp of smoke, which can be captured inside a glass ball for later viewing.²⁴⁴ When needed, the memory can be removed and replayed with a vividness and immediacy that gives the observer the feeling of actually being present at the events recalled.²⁴⁵ In many ways, this is a very helpful analogy, because if indeed a retrieved memory can be replayed, it will only be in the form it was originally taken in. Without the use of this magical device, we are forced to acknowledge that real memories may be subconsciously altered or fade over time.

D. Imposing a Moratorium

The American criminal justice system lacks a central authority which could easily impose a moratorium on any specific forensic technique; the federal government and each of the fifty states maintain separate systems. However, the history of discredited forensic scientific techniques provides a roadmap for reform and some lessons for caution. The most common way for a technique to be barred is through its failure to meet current standards of admissibility for scientific evidence. The best example comes from the history of polygraph evidence, which was first barred from federal courts by the D.C. Circuit Court in *Frye v. United States* because it had not gained “general acceptance in the particular field in which it belongs.”²⁴⁶

This ban was not categorical, however, and today evidence from polygraphy must satisfy the Federal Rules of Evidence under *Daubert*.²⁴⁷ The result of this method has been a patchwork in which

²⁴⁴ E.g., J.K. ROWLING, HARRY POTTER AND THE HALF-BLOOD PRINCE 198 (2005). See generally *The Pensieve*, LANGUAGE REALM, <http://www.languagerealm.com/hplang/pensieve.php> (last visited Feb. 11, 2016).

²⁴⁵ See *The Pensieve*, *supra* note 244.

²⁴⁶ *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

²⁴⁷ See *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993).

various federal district courts and appellate courts have adopted different interpretations for admissibility which then may, or may not, be resolved by the Supreme Court.²⁴⁸

Admissibility tests similarly vary not only between states, but also vary within a state, even when the United States Supreme Court has spoken on the issue. Some states and the U.S. military, however, have actually barred polygraphy evidence by statute as a method of bolstering or disputing the truthfulness of witness testimony, which obviates the need for its being introduced and challenged in each jurisdiction.²⁴⁹ The statutory moratoriums are far more efficient and, in the case of neuroimaging technology, could be developed as a model rule which would be proposed in individual state legislatures and Congress.

V

BEYOND A MORATORIUM: PROPOSALS FOR LIMITING THE DANGER OF PREMATURE USE OF INFORMATION OBTAINED BY ANALYZING NEUROIMAGING DATA PURPORTING TO IDENTIFY HUMAN MEMORY

Until there are uniform standards for interpreting neuroimaging data for testimonial purposes, states and the federal government should impose a moratorium on the use of fMRI imaging as a method of truth verification for any forensic or investigatory purpose. Without those standards, it is impossible to effectively counter testimony interpreting the data. In the interim, however, there are several steps which can, and should, be taken if neuroimaging is going to be used in criminal investigations or in court. Some of these solutions have been proposed in the context of limits on the introduction of other forensic sciences.²⁵⁰

The National Research Council's (NRC) proposed framework for using neuroimaging evidence is a useful starting point. One of their

²⁴⁸ See, e.g., *United States v. Cordoba*, 104 F.3d 225, 228–29 (9th Cir. 1997) (holding *Daubert* overruled per se inadmissibility of polygraph evidence); *United States v. Williams*, 95 F.3d 723, 730 (8th Cir. 1996) (acknowledging potential for polygraph evidence to be misleading under FED. R. EVID. 403); *Conti v. Comm'r*, 39 F.3d 658, 663 (6th Cir. 1994), cert. denied, 514 U.S. 1082 (1995) (“[U]nilaterally obtained polygraph evidence is almost never admissible under Evidence Rule 403.”).

²⁴⁹ See, e.g., MIL. R. EVID. 707(a) (making results from polygraph testing inadmissible in court martial proceedings); N.Y. CRIM. PROC. LAW § 160.45(1) (2015) (prohibiting requiring sexual assault victims to submit to polygraph tests).

²⁵⁰ See Michael J. Saks & David L. Faigman, *Expert Evidence after Daubert*, 1 ANN. REV. L. SOC. SCI. 105, 126–28 (2005). Law Professors Michael Saks and David Faigman have been very active in proposing reforms to the entire system introducing forensic scientific evidence and have several proposals that would mitigate the prejudicial effects of potentially misleading information reaching the jury.

umbrella suggestions which would greatly improve the consistency and fairness of forensic science in U.S. courts is to create independently operated centers for forensic examination sponsored by non-profit or government agencies.²⁵¹ Access to all forensic sciences depends on the availability of money to pay for both testing and expert testimony, but this is of particular concern in neuroimaging because the equipment is expensive and the experts few. Even if the underlying technology achieves acceptable rates of reliability and accuracy, these tests should be restricted to independently run centers equally available to the defense and prosecution.

Many of the NRC’s recommendations are simply good practice. For example, allowing both parties to examine technicians who conducted the test and experts who analyzed data before motions *in limine*; requiring that the examining and testifying experts be available at the motion *in limine* stage for the judge to assess their credibility; and if the evidence is admitted, mandating that the jury hear testimony to rebut the reliability of the neuroimaging’s technique and analysis.²⁵²

Another necessary safeguard concerns the possibility that neuroimaging evidence will be introduced through a report rather than a testifying expert. It is particularly important with regard to this new technology that the reports of neuroimaging experts be understood as interpretations and not as facts.

Finally, to avoid the risk that a jury believes it cannot reject the findings of a “truth machine” anytime this testimony is offered, there must also be jury instructions, such as the ones routinely given regarding testimony by a police officer, that the jury retains ultimate responsibility for all determinations of credibility.²⁵³

CONCLUSION

This Article has considered claims that neuroimaging technology can benefit the justice system by providing direct access to the thoughts of an unwilling witness. It does this first by describing the claims of forensic fMRI developers. Second, it puts those claims to the legal test

²⁵¹ See generally NAS Report, *supra* note 99.

²⁵² See generally *id.*

²⁵³ See Note, *supra* note 33 (discussing how additional jury instructions will allow better assessment of the relative value of different pieces of evidence presented at trial by informing juries of specific problems with and reliability metrics for different types of evidence).

that all scientific evidence must satisfy to be presented to a jury: does it surpass the jury's own basic abilities and, if so, to what extent? Third, it reviews the claims made for neuroimaging in the context of the current criticisms raised by advocates of the wrongly convicted about the danger of overvaluing eyewitness testimony.

The research of science of memory as applied to eyewitness testimony scientifically proves what most people already know intuitively: people present at the same event can sincerely believe that they are truthfully describing it even though their descriptions are mutually inconsistent. Thus, whether memories of past events are offered willingly through eyewitnesses or extracted by technology, the contents of any one person's memories and thoughts are a construct individual to that person, not a process of retrieving a mechanical recording.

While many forensic sciences can be criticized on these grounds, technology that purports to directly access thoughts is particularly pernicious because it advances the scientifically unsupportable proposition that these thoughts are an unfiltered record of past events. The information obtained from neuroimaging is not now, and never will be, reliable for the purposes of either truth verification or reading thoughts because it claims to directly access thought and memory, which are malleable products of individuals' brains. The inherent limitations of a technology which accesses thoughts prevents it from being an improvement over current investigatory techniques or juror determinations of credibility. Finally, the guarantee of a fair trial and normative principles of fairness weigh against the adoption of a technology which does not materially assist a jury in assessing the credibility of witnesses. Rather neuroimaging technology will prejudice a fair trial by suggesting that direct access to the brain is a direct access to past events at which the witness was present regardless of attempts to limit prejudice.